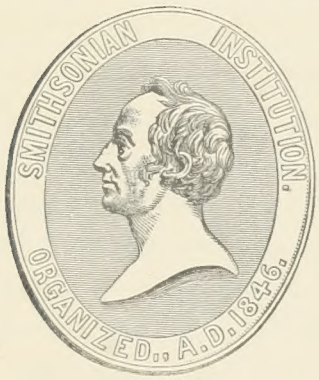
SMITHSONIAN

CONTRIBUTIONS TO KNOWLEDGE.

VOL. V.

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM



EVERY MAN IS A VALUABLE MEMBER OF SOCIETY, WHO, BY HIS OBSERVATIONS, RESEARCHES, AND EXPERIMENTS, PROCURES KNOWLEDGE FOR MEN.—SMITHSON.

CITY OF WASHINGTON:
PUBLISHED BY THE SMITHSONIAN INSTITUTION.
MDCCCLIII.

ADVERTISEMENT.

THIS volume forms the fifth of a series, composed of original memoirs on different branches of knowledge, published at the expense, and under the direction, of the Smithsonian Institution. The publication of this series forms part of a general plan adopted for carrying into effect the benevolent intentions of JAMES SMITHSON, Esq., of England. This gentleman left his property in trust to the United States of America, to found, at Washington, an institution which should bear his own name, and have for its objects the "*increase* and *diffusion* of knowledge among men." This trust was accepted by the Government of the United States, and an Act of Congress was passed August 10, 1846, constituting the President and the other principal executive officers of the general government, the Chief-Justice of the Supreme Court, the Mayor of Washington, and such other persons as they might elect honorary members, an establishment under the name of the "SMITHSONIAN INSTITUTION FOR THE INCREASE AND DIFFUSION OF KNOWLEDGE AMONG MEN." The members and honorary members of this establishment are to hold stated and special meetings for the supervision of the affairs of the Institution, and for the advice and instruction of a Board of Regents, to whom the financial and other affairs are intrusted.

The Board of Regents consists of three members *ex officio* of the establishment, namely, the Vice-President of the United States, the Chief-Justice of the Supreme Court, and the Mayor of Washington, together with twelve other members, three of whom are appointed by the Senate from its own body, three by the House of Representatives from its members, and six persons appointed by a joint resolution of both houses. To this Board is given the power of electing a Secretary and other officers, for conducting the active operations of the Institution.

To carry into effect the purposes of the testator, the plan of organization should evidently embrace two objects: one, the increase of knowledge by the addition of new truths to the existing stock; the other, the diffusion of knowledge, thus increased, among men. No restriction is made in favor of any kind of knowledge; and, hence, each branch is entitled to, and should receive, a share of attention.

The Act of Congress, establishing the Institution, directs, as a part of the plan of organization, the formation of a Library, a Museum, and a Gallery of Art, together with provisions for physical research and popular lectures, while it leaves to the Regents the power of adopting such other parts of an organization as they may deem best suited to promote the objects of the bequest.

After much deliberation, the Regents resolved to divide the annual income into two equal parts—one part to be devoted to the increase and diffusion of knowledge by means of original research and publications—the other half of the income to be applied in accordance with the requirements of the Act of Congress, to the gradual formation of a Library, a Museum, and a Gallery of Art.

The following are the details of the two parts of the general plan of organization provisionally adopted at the meeting of the Regents, Dec. 8, 1847.

DETAILS OF THE FIRST PART OF THE PLAN.

I. To increase Knowledge.—*It is proposed to stimulate research, by offering rewards for original memoirs on all subjects of investigation.*

1. The memoirs thus obtained, to be published in a series of volumes, in a quarto form, and entitled "Smithsonian Contributions to Knowledge."

2. No memoir, on subjects of physical science, to be accepted for publication, which does not furnish a positive addition to human knowledge, resting on original research; and all unverified speculations to be rejected.

3. Each memoir presented to the Institution, to be submitted for examination to a commission of persons of reputation for learning in the branch to which the memoir pertains; and to be accepted for publication only in case the report of this commission is favorable.

4. The commission to be chosen by the officers of the Institution, and the name of the author, as far as practicable, concealed, unless a favorable decision be made.

5. The volumes of the memoirs to be exchanged for the Transactions of literary and scientific societies, and copies to be given to all the colleges, and principal libraries, in this country. One part of the remaining copies may be offered for sale; and the other carefully preserved, to form complete sets of the work, to supply the demand from new institutions.

6. An abstract, or popular account, of the contents of these memoirs to be given to the public, through the annual report of the Regents to Congress.

II. To INCREASE KNOWLEDGE.—*It is also proposed to appropriate a portion of the income, annually, to special objects of research, under the direction of suitable persons.*

1. The objects, and the amount appropriated, to be recommended by counsellors of the Institution.

2. Appropriations in different years to different objects; so that, in course of time, each branch of knowledge may receive a share.

3. The results obtained from these appropriations to be published, with the memoirs before mentioned, in the volumes of the Smithsonian Contributions to Knowledge.

4. Examples of objects for which appropriations may be made:—

(1.) System of extended meteorological observations for solving the problem of American storms.

(2.) Explorations in descriptive natural history, and geological, mathematical, and topographical surveys, to collect materials for the formation of a Physical Atlas of the United States.

(3.) Solution of experimental problems, such as a new determination of the weight of the earth, of the velocity of electricity, and of light; chemical analyses of soils and plants; collection and publication of articles of science, accumulated in the offices of Government.

(4.) Institution of statistical inquiries with reference to physical, moral, and political subjects.

(5.) Historical researches, and accurate surveys of places celebrated in American history.

(6.) Ethnological researches, particularly with reference to the different races of men in North America; also explorations, and accurate surveys, of the mounds and other remains of the ancient people of our country.

I. To DIFFUSE KNOWLEDGE.—*It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge not strictly professional.*

1. Some of these reports may be published annually, others at longer intervals, as the income of the Institution or the changes in the branches of knowledge may indicate.

2. The reports are to be prepared by collaborators, eminent in the different branches of knowledge.

3. Each collaborator to be furnished with the journals and publications, domestic and foreign, necessary to the compilation of his report; to be paid a certain sum for his labors, and to be named on the title-page of the report.

4. The reports to be published in separate parts, so that persons interested in a particular branch, can procure the parts relating to it, without purchasing the whole.

5. These reports may be presented to Congress, for partial distribution, the remaining copies to be given to literary and scientific institutions, and sold to individuals for a moderate price.

The following are some of the subjects which may be embraced in the reports:—

I. PHYSICAL CLASS.

1. Physics, including astronomy, natural philosophy, chemistry, and meteorology.
2. Natural history, including botany, zoology, geology, &c.
3. Agriculture.
4. Application of science to arts.

II. MORAL AND POLITICAL CLASS.

5. Ethnology, including particular history, comparative philology, antiquities, &c.
6. Statistics and political economy.
7. Mental and moral philosophy.
8. A survey of the political events of the world; penal reform, &c.

III. LITERATURE AND THE FINE ARTS.

9. Modern literature.
10. The fine arts, and their application to the useful arts.
11. Bibliography.
12. Obituary notices of distinguished individuals.

II. To diffuse Knowledge.—*It is proposed to publish occasionally separate treatises on subjects of general interest.*

1. These treatises may occasionally consist of valuable memoirs translated from foreign languages, or of articles prepared under the direction of the Institution, or procured by offering premiums for the best exposition of a given subject.

2. The treatises to be submitted to a commission of competent judges, previous to their publication.

DETAILS OF THE SECOND PART OF THE PLAN OF ORGANIZATION.

This part contemplates the formation of a Library, a Museum, and a Gallery of Art.

1. To carry out the plan before described, a library will be required, consisting, 1st, of a complete collection of the transactions and proceedings of all the learned societies in the world; 2d, of the more important current periodical publications, and other works necessary in preparing the periodical reports.

2. The Institution should make special collections, particularly of objects to verify its own publications. Also a collection of instruments of research in all branches of experimental science.

3. With reference to the collection of books, other than those mentioned above, catalogues of all the different libraries in the United States should be procured, in order that the valuable books first purchased may be such as are not to be found elsewhere in the United States.

4. Also catalogues of memoirs, and of books in foreign libraries, and other materials, should be collected, for rendering the Institution a centre of bibliographical knowledge, whence the student may be directed to any work which he may require.

5. It is believed that the collections in natural history will increase by donation, as rapidly as the income of the Institution can make provision for their reception; and, therefore, it will seldom be necessary to purchase any article of this kind.

6. Attempts should be made to procure for the gallery of art, casts of the most celebrated articles of ancient and modern sculpture.

7. The arts may be encouraged by providing a room, free of expense, for the exhibition of the objects of the Art-Union, and other similar societies.

8. A small appropriation should annually be made for models of antiquity, such as those of the remains of ancient temples, &c.

9. The Secretary and his assistants, during the session of Congress, will be required to illustrate new discoveries in science, and to exhibit new objects of art; distinguished individuals should also be invited to give lectures on subjects of general interest.

In accordance with the rules adopted in the programme of organization, each memoir in this volume has been favorably reported on by a Commission appointed

for its examination. It is however impossible, in most cases, to verify the statements of an author; and, therefore, neither the Commission nor the Institution can be responsible for more than the general character of a memoir.

The following rules have been adopted for the distribution of the quarto volumes of the Smithsonian Contributions:—

1. They are to be presented to all learned societies which publish Transactions, and give copies of these, in exchange, to the Institution.

2. Also, to all foreign libraries of the first class, provided they give in exchange their catalogues or other publications, or an equivalent from their duplicate volumes.

3. To all the colleges in actual operation in this country, provided they furnish, in return, meteorological observations, catalogues of their libraries and of their students, and all other publications issued by them relative to their organization and history.

4. To all States and Territories, provided there be given, in return, copies of all documents published under their authority.

5. To all incorporated public libraries in this country, not included in either of the foregoing classes, now containing more than 7000 volumes; and to smaller libraries, where a whole State or large district would be otherwise unsupplied.

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SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

A

FLORA AND FAUNA

WITHIN

LIVING ANIMALS.

BY

JOSEPH LEIDY, M. D.,
PHILADELPHIA.

[ACCEPTED FOR PUBLICATION, DECEMBER, 1851.]

COMMISSION

TO WHICH THIS PAPER HAS BEEN REFERRED.

Prof. J. W. Bailey.
Charles F. Beck, M. D.

Joseph Henry,
Secretary S. I.

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INTRODUCTION.

The recent excellent works by Dujardin,[1] Diesing,[2] and Robin,[3] upon animal and vegetable parasites of living animals, render another systematic record of the labors in this field almost superfluous; and the object of the present memoir is simply to give the result of a series of observations, commenced several years ago, upon associated entozoa and entophyta, constituting a flora and fauna within animals.

The existence of entozoa, or of animals living within other species has, from the most remote time, attracted attention, on account of the peculiarity of their position, the unpleasant ideas associated with them, the sufferings they frequently induce, and the difficulty of explaining their mode of origin.

The entozoa have always constituted the strongest support of the doctrine of equivocal or spontaneous generation, one which has found distinguished disciples even to the present time; but since the days when barnacles were supposed to originate from the foam of the ocean, and ducks and geese to be developed from barnacles, this belief has been so weakened by the accumulation of facts, undenied and undeniable by the supporters of the doctrine, that it bids fair soon to be little more than an echo of the past.

The existence of vegetable parasites within animals, or of entophyta, from their minuteness, remained unknown, until the microscope of Leeuwenhoek detected the algoid filaments of the human mouth; but it is only within a comparatively recent period that any large number of distinct parasitic plants has been discovered.

The very great majority of modern observations indicate that entozoa and entophyta are produced from germs derived from parents, and having a cyclical development.

A great difficulty in determining the course of this development, particularly with entozoa, is, that their various stages of existence are passed under totally different circumstances; sometimes within one organ and then another of the same animal; sometimes in several animals; and, at other times, even quite external to and independent of the animals they infest. If, however, an entozoon preserved the same form throughout its migrations, the difficulty just mentioned would be

[1] Histoire Naturelle des Helminthes, Paris, 1845.

[2] Systema Helminthum, Vindobonæ, 1850.

[3] Des Végétaux qui croissent sur l'homme et sur les animaux vivants, Paris, 1847.

easily overcome; but such is not the case; for the alteration of form is frequently, and probably always, so great that two successive conditions cannot be recognized as the same.[1]

When, however, entozoa have been traced to their highest condition of development, they have always been found to possess well-characterized organs of reproduction, and the females contain such multitudes of eggs as to render it no longer surprising to find intestinal worms so frequently in vast quantities. The entophyta, when fully studied, have been satisfactorily traced to sporules.

Under the circumstances above mentioned, it is very unreasonable even to suppose the necessity of spontaneous generation for animals, which, in such very numerous instances have been proved to possess as great capabilities of reproduction

[1] Thus, almost everybody is familiar with the *Gordius*, or hair-worm, vulgarly supposed to be a transformed horse-hair. The animal is rather common in brooks and creeks in the latter part of summer and in autumn, occurring from a few inches to a foot in length. Its color passes through all shades of brown to black, and it is perfectly hairlike in its form, except that in the male the tail end is bifurcated, in the female trifurcated (American species). No one has yet been able to trace the animal to its origin! The female deposits in the water, in which it is found, millions of eggs, connected together in long cords. In the course of three weeks, the embryos escape from the eggs, of a totally different form and construction from the parents. Their body is only the 1-450th of an inch long, and consists of two portions; the posterior cylindrical, slightly dilated and rounded at the free extremity, where it is furnished with two short spines; and the anterior broader, cylindrical, and annulated, having the mouth furnished with two circlets of protractile tentaculæ and a club-shaped proboscis. No one has yet been able to determine what becomes of the embryo in its normal cyclical course. Those which I have observed, always died a few days after escaping from the egg.

The grasshoppers in the meadows below the city of Philadelphia are very much infested with a species of *Gordius*, probably the same as the former, but in a different stage of development. More than half the grasshoppers in the locality mentioned contain them; but those in drier places, as in the fields west and north of Philadelphia, are quite rarely infested, for I have frequently opened large numbers without finding one worm.

The number of *Gordii* in each insect varies from one to five, their length from three inches to a foot; they occupy a position in the visceral cavity, where they lie coiled among the viscera, and often extend from the end of the abdomen forward through the thorax even into the head; their bulk and weight are frequently greater than all the soft parts, including the muscles, of their living habitation. Nevertheless, with this relatively immense mass of parasites, the insects jump about almost as freely as those not infested.

The worms are milk-white in color, and undivided at the extremities. The females are distended with ova, but I have never observed them extruded.

When the bodies of grasshoppers, containing these entozoa, are broken and lain upon moist earth, the worms gradually creep out and pass below its surface. Some specimens which crawled out of the bodies of grasshoppers, and penetrated into earth contained in a bowl, last August, have undergone no change, and are alive at the present time (November, 1852).

In the natural condition, when the grasshoppers die, the worms creep from the body and enter the earth; for, suspecting the fact, I spent an hour looking over a meadow for dead grasshoppers, and, having discovered five, beneath two of them, several inches below the surface, I found the *Gordii* which had escaped from the corpses.

Some of the worms put in water lived for about four weeks, and then died from the growth of *Achlya prolifera*. What is their cyclical development?

The facts presented in this note serve well to show the difficulties in ascertaining the developmental history of entozoa.

as those whose cyclical development is more evident; and it remains for the supporters of the doctrine to present one single direct observation, before even its probability can be asserted.

To learn fully the nature, origin, and most favorable conditions of entozoic and entophytic life, we must commence our investigations with a clear view of the character and conditions of life in general.

An attentive study of geology proves that there was a time when no living bodies existed upon the earth.

The oblately spheroidal form of the earth, and the physical constitution of its periphery, indicate that it was once in a molten state.

A progressively increasing temperature in descending into the interior of the earth beyond the solar influence, with the phenomena of volcanoes, earthquakes, hot springs, etc., are strong evidences that the central mass of this planet yet preserves its early igneous condition.

The period which elapsed was incalculably great before the earth-crust upon its liquid nucleus had sufficiently cooled by the radiation of its heat for living beings to become capable of existing upon its surface. Not until the temperature had been reduced below the boiling point of water (212° F.), could life have originated, for water in its liquid condition is necessary to the simplest phenomenon of life. It is even highly probable that no living thing appeared upon the earth's surface until its temperature had fallen below 165°. This ordinarily is the highest point at which albumen coagulates,[1] a substance in the liquid form, probably existent in all living beings, and essential to the performance of the simplest vital phenomenon.

Living beings, characterized by a peculiar structure and series of phenomena, appeared upon earth at a definite though very remote period.

Composed of the same ultimate elements which constitute the earth, they originated in the pre-existing materials of their structure.

Living beings originate in a formless liquid matter. The first step in organization is the appearance of a solid particle. An aggregation of organic particles constitutes the spherical, vesicular, nucleolated, nucleated body, the organic cell, the type of the physical structure or organization of living beings.

The phenomena which characterize the living being are: 1. Origin, or birth; 2, nutrition and assimilation; 3, exuration;[2] 4, development and growth; 5, reproduction; 6, death. These, in the aggregate, constitute life.

The origin or birth of a living being, is the appearance of its first particle, whether directly from inorganic nature or from a parent. There is a birth to every organic cell.

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[1] Vegetable albumen coagulates from 140° to 160° F.; animal albumen, from 145° to 165°.—Turner's *Chemistry*, American edition, pp. 740, 744.

Albumen in the liquid state "on being heated to 140° begins to give indications of coagulating: if the solution is very dilute, the temperature may be raised to 165° with the occurrence of this change; and when present in very small quantity, the albumen may not separate till the fluid boils, or even until the ebullition has been prolonged for a short time."—Simon's *Chemistry of Man*, Am. ed. 1846, p. 24.

[2] *Exuro*, I consume.

Nutrition and assimilation are associated in all living actions, being coeval with the birth of a living being, and ceasing only upon its death.

During life, particles of the living structure become effete, and are removed by consumption or exuration, through the agency of the oxygen of the atmosphere. This process has been confounded with that of respiration, a function of especial organs, the lungs, branchiæ, and tracheæ, which exist in higher animals only; it is really secondary to the more important process of life, exuration. Exuration occurs in plants as well as in animals; in germination of the seed and in inflorescence it is very evident. In the growing plant, exuration is usually masked by the peculiar character and activity of the process of nutrition; but, at night, when the nutrition of the plant is at rest, the exuration becomes marked in the evolution of carbonic acid.

Development and growth are definite in each species of living being.

Reproduction perpetuates the structure as well as the species of the living being.

Death commences with life in the destruction of effete molecules of structure; it is the cessation of all life-phenomena in the individual, or is the last phenomenon of life.

To live, requires certain indispensable conditions never absent from life; always preceding it. These consist of the specific components of the living body together with the constant presence of water, air, and a definite range of temperature.

The constituent matter of living beings necessarily precedes the phenomena of life.

Without water there could be no movement to indicate life.

Air is necessary to exuration. No living being is found out of its influence. The minutest radicle of a plant never penetrates into the earth beyond the access of air.

The range of temperature necessary to life is between 35° F.[1] and 135° F.[2]

Life cannot exist independently of any one of the above-mentioned conditions. In very many instances, the removal of certain of the indispensable conditions of life-action may take place without the destruction of the power of living when these conditions are restored. Thus, many plants and animals, seeds and eggs, may be dried; yet, upon supplying moisture to them, with all the other conditions, they will again present the characteristic phenomena of life.

The indispensable conditions of life are susceptible of a great variety of modification, within a definite range, without its destruction.

Accompanying a variation of the essential conditions of life, is presented the

[1] The so-called red-snow, *Protococcus nivalis*, Agardh., an algous plant of polar and alpine regions, grows and reproduces only upon thawing snow, though it may be found beneath virgin snow and in a temperature far below zero; nevertheless, in such circumstances it has ceased all activity, and may remain so for a long period. The plant is remarkably indestructible. I have a specimen contained in melted snow-water, yet alive and of a red color, December, 1852, which was brought by the enterprising traveller, Dr. E. K. Kane, U.S.N., from Cape Beverly, latitude 76.10, during the Grinnell expedition for 1850–51, in search of Sir John Franklin.

[2] Certain algæ grow in thermal springs, of the temperature of 117° F.

immense number of specific and individual peculiarities of living beings. The variation consists in the difference of the relative quantities of the indispensable conditions required and supplied, in addition to a modifying influence of light, probably of electricity, and possibly of some other but yet unknown agency.

The absence or presence of light is a highly important modifying condition to those indispensable to life. With the solar light, we find the green plant, which constitutes the basis of life with most terrestrial animals. Without it, the green plant and its dependent animals could not exist, but another race, now represented by certain cryptogamia, and the animal denizens of dark caverns, might inhabit the earth.

A species of plant or animal may be defined to be an immutable organic form, whose characteristic distinctions may always be recognized by a study of its history.

Any species may present individual forms not characteristic; for all, in the progress of development and course of life, are liable to modification within definite limits, which cannot be transcended without cessation of action. The original proposition is, however, not affected, for no one has ever been able to demonstrate the transmutation of one species into another.

The most ordinary and extensive modifications of species from the characteristic type are presented by arrests of development. Hence, the necessity of studying the history or cyclical course of a species in order to be capable of always recognizing it.

A modification of condition beyond the range of specific life-action, must, necessarily, result in the extinction of the species.

The study of the earth's crust teaches us that very many species of plants and animals became extinct at successive periods, while other races originated to occupy their places. This probably was the result, in many cases, of a change in exterior conditions incompatible with the life of certain species, and favorable to the primitive production of others. But such a change does not always satisfactorily explain the extinction of species.[1]

Probably every species has a definite course to run in consequence of a general law; an origin, an increase, a point of culmination, a decline, and an extinction. Within this course there may occur, under the influence of ordinary circumstances, cycles of temporary increase and diminution, until, finally, the entire machine of life of the species runs down.

The historical period of man is too short to ascertain with certainty whether such a view be correct, but it appears to be favored by analogy. The power of reproduction is limited in each individual. Plants may be reproduced to an incalculable extent by cuttings, but ultimately the power to reproduce in this manner

[1] Thus, there are numerous instances of species of animals which have become extinct, and their place supplied by others so closely allied, that it is difficult to comprehend how the exterior conditions for their existence should be so different; as in the case of the *Equus primigenius*, *E. Americanus*, &c., which have given place to the *E. caballus*, the *Bos primigenius*, whose place is supplied by the *Bos taurus*, the *Bison latifrons* by the *Bison Americanus*, &c.

becomes exhausted. The perennial plant puts forth phyton after phyton, but the seed is necessary to its perpetuation. Numerous lower animals are reproduced to a vast extent by segmentation or allied processes, but ultimately a recurrence to sexual admixture becomes necessary for the preservation of the species.[1] Sexual admixture, limited to a few families of a species, soon ends in their extinction. Finally, the complex living being, from birth to death, produces an immensity of living organisms, the organic cells; but the egg and seed are necessary to insure the species against extinction.

Living beings did not exist upon earth prior to their indispensable conditions of action, but wherever these have been brought into operation concomitantly, the former originated; and for such an immensity of time and vastness in quantity, have they existed, that most of the superficial rocks of the earth's crust are composed of their remains.

The stratum of life has been always subjected to the destructive agency of earthquakes, volcanoes, and torrents; but it is wonderful how soon, under the play of the life-conditions, the new surface again teems with living beings. Here and there, upon the wide area of the earth, an igneous rock peeps out as if to observe the monopoly of life, but even this, in the progress of time, has its steep sides hidden by lichens and its summit enveloped in verdure.

Of the life, present everywhere with its indispensable conditions, and coeval in its origin with them, what was the immediate cause? It could not have existed upon earth prior to its essential conditions; and is it, therefore, the result of these?

There appear to be but trifling steps from the oscillating particle of inorganic matter, to a *Bacterium;* from this to a *Vibrio*, thence to a *Monas*, and so gradually up to the highest orders of life! The most ancient rocks containing remains of

[1] Instances in favor of this view are numerous; among others, I have met with a striking example in the case of a worm, to which I have given the name of *Stylaria fossularis* (Proc. Acad. Nat. Sci. V. 287). This worm is found abundantly in ditches in the neighborhood of Philadelphia, during warm weather, and is constantly observed to be undergoing division. Individuals, a third of an inch long, are usually found to consist of two divisions, and occasionally of three, in various stages of progress towards separation. The divisions are composed of about twenty-two annulations, each possessed of a pair of fasciculi of five podal spines and two bristles. The head consists of a large lobe, with a long digit-like appendage, and presents an eye upon each side of a large mouth. The latter opens into a capacious pharynx, which afterwards contracts into a cylindrical œsophagus, continuous with a well-developed intestine, but within the animal no trace of a generative apparatus can be perceived.

In the course of a season, a single individual may reproduce some millions simply by segmentation; but as cold weather approaches, we find the animal to lose this power—not resulting from the influence of the cold, but from exhaustion of the power; because, even if the worms be placed in a warm situation, as in the window of a warm room, where the sun may shine upon the vessel containing them, they are observed to cease division. The loss of power of this mode of reproduction, is, however, compensated for by another succession of developments.

The worms grow to an inch in length and are composed of sixty annulations, each being provided with double the previous number of podal spines. Within the body, an androgynous generative apparatus becomes developed; within the ovaries are developed ova, and within the testis, spermatozoa. Two individuals copulate, eggs contained in bottle-shaped cases are extruded, and ultimately the parent dies.

After some weeks, in a warm situation, the ova are hatched, the young escape and move freely about, and soon commence to reproduce their numbers by division.

living beings, indicate the contemporaneous existence of the more complex as well as the simplest of organic forms; but, nevertheless, life may have been ushered upon earth, through oceans of the lowest types, long previously to the deposit of the oldest palæozoic rocks as known to us!!

The primitive species of living beings which appeared upon earth, and those which have been successively and periodically produced, must have been the result of pre-existing natural conditions, or the former alone originated in this manner, and the latter were the result of their transmutation under the influence of varying exterior conditions, or all species in all times originated directly through supranatural agency.

The last mode, of course, can only be an inference, in absence of all other facts; and if living beings did not originate in this way, it follows they are the result of natural conditions.

Be this as it may, the most prolonged and closest observations, and the most carefully conducted experiments have not led to the proof of a single instance of spontaneous or equivocal generation even of one of the simplest of all living beings; but, on the contrary, they all lead farther and farther from or entirely disprove it, and thus involve the whole subject in obscurity.

Schulze[1] performed an experiment to test the possibility of equivocal generation under the play of the indispensable conditions of life, free from access to any pre-existing vegetable or animal germs.

A glass vessel half filled with a mixture of various dead vegetable and animal substances in water, was heated to 212° F., so as to destroy any living bodies which might exist within. To the vessel was then adapted a pair of Liebig's bulbs, one of which contained sulphuric acid, the other a solution of potassa, and through these only could the exterior air have access to its interior. The apparatus was then placed in a window, where it received the full influence of light and the necessary temperature for the production of life. The air within the vessel was daily renewed from May until August, by blowing through the sulphuric acid, from which it could suffer no change, except to be deprived of moisture and organic particles. During all that time, not even the simplest animal or vegetable forms were produced, while in an open vessel containing the same mixture, in the same situation, there were observed on the following day numerous Vibrios and Monades, and to these were soon added larger animalculæ.

This interesting experiment of Schulze, I repeated with three different vessels; in one of which was a mixture of ditch-mud and confervæ with water; in a second, decaying wood with water; and, in the third, a clod of earth with growing grass, earth-worms, and water. Exactly under the same circumstances, they were supplied with fresh air from time to time, from July of 1850 to December of 1851, and in the end the results were the same as in the experiment of Schulze.

These experiments, however, may not be conclusive; other conditions may be

[1] Notice of the Result of an Experimental Observation made regarding Equivocal Generation. By F. Schulze, Berlin. The *Edinburgh New Philosophical Journal*, vol. xxiii. 1837, p. 165.

required: what might have been the influence of a long-continued current of electricity, under the same circumstances, upon the mixtures?

The experiments of Crosse and Weekes, in the production of the so-called *Acarus Crossii*, were performed under the least favorable circumstances to the origination of life, and, although neither an Acarus nor a Homunculus has been created under the inspection of man, yet ridicule or prejudice should not prevent us from making every observation and experiment which can bear on the subject, in order that we may say positively whether living beings do or do not originate from the inorganic world under natural and still-existing conditions.[1]

To the present, we are totally unacquainted with the mode of the primitive origin of living beings!

Each species once in existence, very generally, and probably universally, requires two distinct elements, denominated sexual, for its perpetuation.

The power of reproduction by segmentation, budding, or the production of numerous successions of asexual fertile generations is, probably, in all cases limited; the species necessarily reverting to sexual admixture for its perpetuation.

The statements of Horkel[2] and Schleiden,[3] and their followers, that true sexes do not exist in the phanerogamia have been most amply refuted by the more careful observations of Amici,[4] Hugo von Mohl,[5] Carl Müller,[6] Hoffmeister,[7] Gasparini,[8] Tulasne,[9] and others.

Sexual elements have also been detected in most of the cryptogamia, and, in a little time, will probably be discovered in all. They have been observed in Ferns,[10] Mosses,[11] and Algæ,[12] but not yet among Fungi.

Having thus taken a cursory glance at the laws of life in general, we have next to consider those especially operating in the production of parasitic life.

Within living beings, *i. e.* within their cavities or the parenchyma of the organs,

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[1] The experiments of Crosse and Weekes appear to me exceedingly absurd; for, in the first case, how were the carbon and nitrogen of the animal body to be derived by the play of a voltaic current upon a solution of silicate of potassa? If they previously existed in the water, was it not quite as probable that the ova of Acari were there also? Again, when the solution of ferrocyanide of potassium was made the womb of life by the electrical current, why could not the embryology of the new being be observed? An Acarus is a highly complex animal, presenting a well-developed tegumentary, muscular, and nervous system, and a digestive, respiratory, and generative apparatus. The gap between the inorganic world and the Acarus is greater than that between the latter and man!

[2] Monatsb. d. Berlin. Akad. 1836.

[3] Archiv f. Naturges. 1837; Nova Acta C. L. C. Acad. Nat. Cur. vol. xix. 1839, p. 27; Grundzüge d. Wissenschaftliche Botanik.

[4] Giornale botanico Italiano, An. 2; Annales des Sciences Naturelles, Botanique, 1847, t. vii. p. 193.

[5] Botanische Zeitung, 1847; An. Sc. Nat., Bot. t. ix. 1848.

[6] Ibid

[7] Ibid. and t. xi. 1849.

[8] Ibid.

[9] Ibid. t. xii. 1849.

[10] Tulasne, ibid. t. xi. p. 5; ibid. p. 114.

[11] Schimper: Recherches Anatom. et Morpholog. sur les Mousses. Strasbourg, 1848. This author says, page 55: "*Mais je tiens le fait que jamais une mousse ne parvient à la fructification quand elle se trouve hors de l'influence des organes que je considère comme des organes mâles.*"

[12] Thwaites, in *Annals and Magazine of Natural History*, 1847, vol. xx. p. 9; ibid. p. 343; ibid. 1848, 2d ser. vol. i. p. 161.

of course all the indispensable conditions of life exist, and consequently we cannot wonder at their being infested with other living beings adapted to their parasitic position. Nevertheless, although the conditions of life are necessarily ever present in living beings, yet these frequently do not contain parasites. There are many circumstances besides those essential to life in general, which influence the existence or non-existence of such forms. One of the most important of these circumstances is the convenience or ease of access, or of entrance to the living body infested.

Within the living, closed, organic cell parasites very rarely if ever exist, because it is liquid matter only which can endosmose through cell-membrane, and, therefore, solid germs cannot enter,[1] and hence the unfrequency of true entozoa in vegetables. Entozoa may and do penetrate through living tissues, but it is entirely by the mechanical process of boring.

The intestinal canal of animals is most frequently infested by entoparasites on account of the ease with which their germs enter with the food.

Aquatic animals are more troubled by entozoa than those which are terrestrial, because the water affords a better medium of access than the air.

Terrestrial animals, on the other hand, are more infested by ectoparasites because their covering of hair, wool, and feathers is more favorable to their protection and reproduction. A low degree of organic activity and slowly digestible food favor the development of entoparasites, and hence they are more frequent in the relatively sluggish herbivora than in the carnivora. Comparatively indigestible food, and such as contains but a small proportion of nutritive matter, from its long retention in the alimentary canal, favors the development of entozoic and entophytic germs more than that in which the contrary conditions prevail.[2]

Animals subsisting upon the endosmosed juices of the tissues of other animals, and of plants, are rarely infested by parasites, as in the case of the hemipterous insects, aphides, etc., because such food is necessarily free from parasites or their germs. Entozoa themselves, on this account, are not infested.

On the other hand, if the liquid food be open to the air, parasitic germs may be readily introduced into the animal, as in the case of the common house-fly, which often contains myriads of a species of *Bodo*.

Food swallowed in large morsels favors the introduction of attached parasites; hence these are frequently found in reptiles, and even in birds, which are, among the vertebrata, of the highest organic activity.

Animals of feeble organic activity using solid food, which is very slowly digested,

[1] In some experiments upon the endosmosis of solid matter through organic cell-membrane, I found that particles of carmine, diffused in water, which I estimated to measure about the 52,000th of an inch, would no more penetrate the cell-membrane than the largest masses.

[2] The inhabitants of the United States appear to be less infested with entozoa than those of any other part of the world. This probably arises to a great extent from the more nutritious character of their food; even the poorest laborer being daily supplied with abundance of wholesome flesh, producing a tendency to high organic activity, which is unfavorable to parasitic development.

and contains little nutriment, are rarely free from parasites. This is the case with the coleopterous insect *Passalus*, and the myriapod *Julus*.

Cooking food is of advantage in destroying the germs of parasites; and hence man, notwithstanding his liability to the latter, is less infested than most other mammalia. Did instinct originally lead him to cook his food, to avoid the introduction of parasites?

Entozoa are more abundant than entophyta, because the power of voluntary movement favors them in their transmigrations, and renders them less liable to expulsion from the intestinal canal.

Influence of Parasites in the Production of Disease.—In many animals entozoa and entophyta are almost never absent, and probably when in their natural habitation, and few in number, or not of excessive size, are harmless, as observed by Dujardin in the introduction of his excellent work on Intestinal Worms: "Les helminthes se développent dans un site qui leur convient, sans nuire plus que les lichens sur l'écorce d'un arbre vigoureux. Ils ne peuvent devenir nuisibles, généralement, que par suite d'une multiplication excessive, laquelle semble alors être une des conséquences d'un affaiblissement provenant d'une tout autre cause, d'une mauvaise alimentation, du séjour dans un lieu froid et humide, etc.: sans cela, les helminthes naissent et meurent dans le corps de leurs hôtes, et peuvent paraître et disparaître alternativement sans inconvénients."

Many important diseases have been supposed to originate from parasitic animals and vegetables. The former are not the true entozoa, for these are too large, and may be detected by the naked eye, but they are considered to be animalculæ so small that they cannot be discovered even with the highest powers of the microscope. But, independent of the fact that the existence of such entities is a mere suspicion, none of the well-known animalculæ are poisonous. At various times, I have purposely swallowed large draughts of water containing myriads of *Monas*, *Vibrio*, *Euglenia*, *Volvox*, *Leucophrys*, *Paramecium*, *Vorticella*, etc., without ever having perceived any subsequent effect.

The production of certain diseases, however, through the agency of entophyta, is no longer a subject of doubt; as in the case of Muscardine in the Silk-worm, the Mycoderm of Porrigo favosa in Man, etc.; but that malarial and epidemic fevers have their origin in cryptogamic vegetables or spores requires yet a single proof.[1] If such were the case, these minute vegetables and spores, conveyed through the air, and introduced into the body in respiration, could be detected. The minutest of all known living beings is the *Vibrio lineola* of Müller, measuring only the 36,000th of an inch, and the smallest known vegetable spore is very much larger than this, whilst particles of inorganic matter can be distinguished the 200,000th of an inch in size.

I have frequently examined the rains and dews of localities in which intermittents were epidemic upon the Schuylkill and Susquehanna Rivers, but without being able to detect animalculæ, spores, or even any solid particles whatever. I

[1] See an ingenious little work by my distinguished friend Dr. J. K. Mitchell, "On the Cryptogamous Origin of Malarious and Epidemic Fevers."

have examined the air itself for such bodies, by passing a current through clear water. This was done by means of a bottle, with two tubes passing through a cork stopper; one tube dipping into the water, the other reaching not quite to its surface. By sucking upon the latter tube, a current of air passed through the former, and was deprived in its course of any solid particles. Ordinarily, when the atmosphere was still, early in the morning, or in the evening, neither spores nor animalcules could be detected. When piles of decaying sticks or dry leaves were stirred up, or the dust was blown about by the wind, a host of most incongruous objects could be obtained from the air; none, however, which could be supposed capable of producing disease.

To assert, under these circumstances, that there are spores and animalculæ capable of giving rise to epidemics, but not discernible by any means at our command, is absurd, as it is only saying in other words that such spores and animalculæ are liquid and dissolved in the air, or in a condition of chemical solution. That the air may be poisoned by matters incapable of detection by the chemist is proved by the emanations from such plants as the *Rhus vernix*, *Hippomane mancinella*, etc.

Parasites of Man.—The list of described species of parasitic animals and plants to which man is liable is already a long one, but nevertheless, in different parts of the world, others will yet be discovered. According to the most authentic sources, the known species are as follow :—

ENTOZOA HOMINIS.

Filaria medinensis, Gmelin. Subcutaneous areolar tissue.
Filaria bronchialis, Rudolphi. Bronchial glands.
Filaria oculi humani, Nordmann. Eye.
Tricocephalus dispar, Rud. Large intestine.
Strongylus gigas, Rud. Kidneys.
Ascaris lumbricoides, Lin. Small intestine.
Ascaris alata, Bellingham. Small intestine. (Ireland.)
Oxyuris vermicularis, Bremser. Rectum.
Spiroptera hominis, Rud. Urinary bladder.
Ancyclostomum duodenale, Dulimi. Small intestine.
Trichina spiralis, Owen. Muscles.
Pentastomum constrictum, Siebold. Small intestine and liver. (Egypt.)
Bothriocephalus latus, Bremser. Intestines.
Tænia solium, L. Small intestine.
Tænia nana, Siebold. Small intestine and liver. (Egypt.)
Monostomum lentis, Gescheidt. Crystalline lens.
Distomum hepaticum, Abilgaard. Gall-bladder and portal vein.
Distomum lanceolatum, Mehlis. Hepatic duct.
Distomum oculi humani, Gescheidt. Capsule of crystalline lens.
Distomum hæmatobium, Bilharz. Portal Vein. (Egypt.)
Distomum heterophyes, Siebold. Small intestine. (Egypt.)
Tetrastomum renale, Chiaje. Kidney.
Hexathyridium pinguicola, Treutler. Ovary.
Hexathyridium venarum, Treut. In the venous blood.
Cysticercus cellulosæ, Rud. Areolar tissue of various organs.
Echinococcus polymorphus, Diesing. Various viscera.

ECTOZOA HOMINIS.

Phthirius inguinalis, Leach. (Crab-louse.)
Pediculus capitis, Nitzsch. (Head-louse.)
Pediculus vestimenti, Nitzsch. (Body-louse.)
Pediculus tabescentium, Burmeister.
Sarcoptes scabiei, Latreille. (Itch-insect.)
Demodex folliculorum, Owen.
Dermanyssus Boryi, Gervais.
Ixodes americanus, De Geer. (Tick.)
Argas persicus, Fischer.
Pulex irritans, Lin. (Common flea.)
Pulex penetrans, Gmelin. (Chiggo.) South America.
Cimex lectularius, Lin. (Bed-bug.)
Oestrus hominis, Say. South America.

ENTOPHYTA HOMINIS.

Alga of the mouth.
Achorion Schönleinii, Remak. In porrigo favosa.
Achorion Lebertii, Robin. In porrigo scutulata.
Microsporium Audouini, Gruby. In porrigo decalvans.
Mycoderm of Plica Polonica.
Mycoderm of Mentagra.
Mycoderm of Muguet.
Mycodermata of ulcerated and mucous surfaces.
Sarcina ventriculi, Goodsir. Stomach.
Torula?[1] Stomach.

[1] I once saw a plant of this kind in great abundance mingled with the *Sarcina ventriculi* in the liquid ejected from the stomach of a man.

CHAPTER I.

DESCRIPTION OF A FLORA WITHIN ANIMALS.

The most extensive associated flora and fauna which I have discovered within animals exists with wonderful uniformity within the intestinal canal of the Myriapod, *Julus marginatus*, Say, and of the Coleopterous insect, *Passalus cornutus*, Fabricius; and in order that the position of the parasites in relation to the different portions of the intestines may be clearly understood, I have considered it proper to give a short anatomical description of the latter.

§ 1.—Of the Anatomy of the Intestinal Canal of Julus marginatus.

(Plate VII. Fig. 21.)

The alimentary canal of *Julus marginatus*, though extending in a straight line from mouth to anus, is very large and capacious in relation to the size of the animal, and is in accordance with the nature of the food.

Opening into the pharynx there are six *salivary glands* (Plate VII.), two of which are pyriform (*a*), conglomerate, and cellular in structure, and placed one upon each side of the œsophagus; the others are long and tubular (*b*).

The *œsophagus* is pyriform and capacious (*c*). The *proventriculus* (*d*) forms nearly half the length of the alimentary canal. It is capacious, cylindroid, and dilates very gradually from its lower third to its termination. Its lower extremity is constricted into six annuli, of which the last is twice the width of the others. The mucous membrane of the proventriculus is smooth, ochreous-yellow in color, and opaque. At the termination of the proventriculus, there open two *biliary tubes* (*e*), and from it, surrounding the commencement of the ventriculus, is suspended a broad, white, opaque, reticulated band (*f*), apparently composed like the rete adiposa of insects.

The *ventriculus* (*g*) forming about one-sixth the whole length of the alimentary canal, is simple, cylindrical, or intestiniform, and is narrower than the proventriculus, and stronger. Upon its exterior surface, it presents several slightly tortuous elevated longitudinal lines. Its lining membrane is smooth, and at the commencement of the organ is provided with a single transverse row of thin, quadrilateral corneous plates.

The *large intestine* (*h*) commences very abruptly; at first being nearly twice the breadth of the ventriculus; but at its lower half, it gradually decreases to its

termination in the rectum, where it is as narrow as the ventriculus. Its parietes present a great number of slight depressions, arranged in quadrangular groups, which latter form longitudinal rows the whole length of the large intestine.

The *rectum* (*i*) is short, elliptical, and presents several narrow internal longitudinal folds or elevated lines, continuous with the longitudinal lines of separation of the rows of quadrangular groups of depressions of the large intestine.

It is within the ventriculus, the large intestine, and the rectum, that the extensive Julidean flora and fauna are found.

§ 2. Of the Anatomy of the Intestinal Canal of Passalus cornutus.

(Plate VI. Figs. 8–10.)

The intestinal canal of *Passalus cornutus*, in accordance with the nature of the animal's food, is capacious, and about three times the length of the body.

The *œsophagus* extends in a straight line as far back as the mesothorax, is capacious and claviform, gradually widening to its posterior fourth, and then narrowing to its termination in the *proventriculus*.

The latter (Pl. VI. Fig. 8, *a*) constitutes about two-thirds of the whole length of the alimentary canal. It makes several transversely circular convolutions within the abdomino-thoracic cavity; it is capacious, and, with the exception of its commencement, which is a little dilated, claviform, is nearly uniformly cylindrical throughout. The mucous membrane of the proventriculus, with the exception of a small portion of its posterior extremity, is studded pretty closely with white circular glands, arranged, though not very regularly, in alternating rows; which, through the translucent parietes of the organ, give it a white maculated appearance. At the junction of the proventriculus with the ventriculus open four biliary tubes.

The *ventriculus* (Fig. 8, *b*; Fig. 9), which in *Passalus* always contains entophytic forests, makes a sigmoid turn from the left backwards, and to the right side. It is one-third broader than the proventriculus; and, for the most part, is constituted of six longitudinal rows of transversely oval sacculi separated by as many intervening folds or ridges. The sacculi are about twenty in number, in each row, separated by transverse folds; they open into the interior of the organ (Fig. 10, *a*). At the commencement of the ventriculus, upon the left side, there projects an oval, curved, *cœcal pouch* (Fig. 9, *b*), apparently formed by the conjunction of two of the ventricular sacculi, though as large as four of them. Within the ventriculus, the lateral borders of the longitudinal folds (Fig. 10, *b*), separating the sacculi, between the transverse folds (*c*), are thickly set with simple, bidentate, and tridentate, amber-colored, corneous spines (Pl. IX. Fig. 1, *d*). These are arranged in two separate and close columns, convergent forwards, and extending backwards in a straggling manner between the ventricular sacculi. Besides these spines, the surface of the mucous membrane is everywhere studded with distant, stiff, corneous, yellow, translucent, hair-like appendages, which, at the edges of the ventri-

cular sacculi, are relatively of considerable length, measuring from the 400th to the 125th of an inch in length, by the 3000th of an inch thick, while the others measure the 1154th of an inch in length.

At the termination of the saccular structure posteriorly, the lining membrane of the ventriculus is provided with a single transverse row of six broad, V-shaped corneous plates (Fig. 10, *d*), followed, after a short interval at the junction of the organ with the fecal intestine, by a thin, yellowish, corneous annulus.

The *fecal intestine* (Fig. 8, *c*) is cylindrical, narrower, and more strongly muscular than the proventriculus, and performs nearly the complete circuit of the abdomen in its course to the anus.

§ 3. Description of the Genus and Species of Enterobryus.

ENTEROBRYUS, Leidy.

Thallus attached, consisting of a single, very long, tubular cell, filled with granules and globules, producing at its free extremity one, usually two, rarely three, shorter tubular cells, and growing at the other end from a relatively short, cylindroid, amorphous, coriaceous pedicle, commencing with a discoidal surface of attachment.

1. Enterobryus elegans, Leidy.

Proc. Acad. Nat. Sci., Phila., iv., 225.

(Plate I. Fig. 1; II.; III. Figs. 1–14; IV. Figs. 1–25, 28.)

Thallus olive brown, brownish, yellowish, or colorless, transparent, cylindrical, usually somewhat clavate at the free end; at first forming a single spiral turn, and then proceeding in a straight or gently flexuose curved line to the free extremity. *Pedicle* variable in length to that of the thallus, cylindroid, more or less transversely contorted, finely striated longitudinally, uniformly brownish in color, commencing in a broad discoidal expansion. *Principal cell* very long, cylindrical, slightly dilated at the commencement, and usually more so, or somewhat clavate at the free end. *Penultimate cell* cylindrical. *Terminal cell* shorter than the last, cylindroid, clavate, curved, obtusely rounded at the extremity.

Whole length, 2 to 3 lines. Length of pedicle $\frac{1}{375}$ to $\frac{1}{400}$ of an inch; breadth $\frac{1}{3200}$ to the $\frac{1}{1666}$ of an inch. Breadth of principal cell, the $\frac{1}{935}$ of an inch. Length of penultimate cell, $\frac{1}{100}$ to the $\frac{1}{80}$ of an inch; breadth, $\frac{1}{1000}$ to $\frac{1}{950}$ inch. Length of terminal cell, $\frac{1}{150}$ to $\frac{1}{125}$ inch; breadth, $\frac{1}{1000}$ to $\frac{1}{625}$ inch.

Habitation. Parasitic, growing from the basement-membrane of the mucous membrane of the small and large intestine of *Julus marginatus*, Say; and from any part of the exterior of *Ascaris inflecta*, *Streptostomum agile*, and *Thelastomum attenuatum*: entozoa infesting the cavities of the viscera, just mentioned.

2. Enterobryus spiralis, Leidy.

Proc. Acad. Nat. Sci., Phila., iv., 249.

(Plate I. Fig. 4.)

Thallus brownish, yellowish, or hyaline, cylindrical, forming a single, double, or triple spiral. *Pedicle* cylindroid, expanded at base, or elongated conical, not contorted, smooth, or faintly striated longitudinally, brownish or yellowish in color. *Principal cell* cylindrical, slightly dilated at the extremities or uniform throughout. *Penultimate cell* cylindrical. *Terminal cell* clavate, curved, obtuse.

Whole length, from $\frac{1}{70}$ to $\frac{1}{50}$ inch. Length of pedicle, $\frac{1}{250}$ inch; breadth, $\frac{1}{600}$ to $\frac{1}{420}$ inch. Breadth of principal cell, $\frac{1}{4285}$ inch. Length of penultimate cell, $\frac{1}{450}$ to $\frac{1}{400}$ inch; breadth, $\frac{1}{4285}$ inch. Length of terminal cell, $\frac{1}{55}$ to $\frac{1}{50}$ inch; breadth, $\frac{1}{3333}$ inch.

Habitation. Attached to the mucous membrane of the small intestine of *Julus pusillus.*

3. Enterobryus attenuatus, Leidy.

Proc. Acad. Nat. Sci., Phila., iv., 249.

(Plate I. Figs. 2, 3; Pl. III. Figs. 15–17; Pl. IV. Figs. 26, 27.)

Thallus faintly brownish, yellowish, or hyaline; forming at first a double flexure or sigmoid curve, and then proceeding in a straight or gentle curvilinear direction to its free extremity. *Pedicle* short, cylindroid, campanulate, or conical with a spreading base, longitudinally striated, simple, occasionally double, uniformly yellowish. *Principal cell* cylindrical, attenuated at both extremities, or very slightly and gradually narrowing from the commencement, or uniform throughout; truncated, or obtusely rounded at the free extremity. *Terminal cells* rare.

Whole length $\frac{1}{2}$ line to 1 line. Length of pedicle $\frac{1}{666}$ to $\frac{1}{600}$ inch by $\frac{1}{2300}$ to $\frac{1}{2000}$ inch broad. Diameter of principal cell; at middle, $\frac{1}{1500}$ inch; at sigmoid curve, $\frac{1}{2300}$ inch; at the free extremity, $\frac{1}{2500}$. In other instances, $\frac{1}{71}\frac{1}{5}$ inch at the sigmoid portion, and gradually decreasing to $\frac{1}{1100}$ inch at the free end. Where uniformly cylindrical, about the $\frac{1}{1700}$ inch in diameter.

Habitation. Grows from the mucous membrane of the ventriculus of *Passalus cornutus.*

§ 4. History, Structure, etc. of Enterobryus.

I first discovered the genus of entoparasitic plants, *Enterobryus*, in the small intestine of *Julus marginatus*, in the autumn of 1848, but published no account of it until October of the following year. From its structure, I immediately supposed it to be a plant; but afterwards, from the constancy of its existence in the small intestine, and firmness of attachment to the mucous membrane of the latter, I began to suspect it might be a part of the structure of the viscus in which it was

found, of the character of villoid appendages. It then occurred to me that if it were a plant, it would probably be also found upon fragments of the ligneous food of the animal within the intestine, which, however, was not the case. On the other hand, I frequently detected it growing from the exterior surface of three species of nematoid entozoa infesting the alimentary canal of *Julus marginatus* with as much constancy as the plant itself. Among several hundred specimens of these worms, consisting of *Ascaris infecta*, *Streptostomum agile*, and *Thelastomum attenuatum*, which I had obtained from numerous individuals of *Julus marginatus*, and preserved in alcohol, I found twenty which had from one to a dozen filaments of *Enterobryus* attached to their exterior surface. Since then, I have observed that on an average about one in twenty of the entozoa will be found to have the plant growing upon it. In one instance, I found a large individual of *Ascaris infecta*, with twenty-three filaments of *Enterobryus* growing from its surface, which appeared to cause no inconvenience to the animal, as it moved and wriggled about with all the ordinary activity of the species (Pl. VI. Fig. 1).

The plant rarely reaches its full growth upon the entozoa, although its attachment is as firm as upon its ordinary seat, the mucous membrane of the cavity infested by the worms.

The principal and constant locality of the *Enterobryus*, and that in which it is most frequently met with in full development, in *Julus marginatus*, is at the commencement of the ventriculus (Pl. VII. Fig. 21, *g*). Lower down it is not so abundant; nor is it in this position usually of large size. In the large intestine (*h*), especially at the lower extremity, it frequently exists in the greatest profusion, but always in a very immature condition.

From the constancy of the presence of *Enterobryus elegans* within *Julus marginatus*, having examined over one hundred of the latter without finding it absent even in a single instance, I was led to suspect its existence within other species of *Julus*, and accordingly sought for it in *Julus pusillus*, a species very much smaller than *Julus marginatus*. Within this I detected the second and smallest species, the *Enterobryus spiralis*.

I found no entozoa within a dozen individuals of *Julus pusillus*, nor did the *Enterobryus* always exist in it; in several there were only two or three filaments; in two others it grew profusely; and in two it was not at all present.

From the occurrence of two species of *Enterobryus* in the two species of *Julus* examined, I suspected entophyta would be found very commonly among the Myriapoda. I therefore examined species of *Cermatia*, *Cryptops*, *Scolopendra*, *Geophilus*, &c., but in none of these carnivorous genera did I discover a trace of a parasitic plant. In two species, however, of another genus of herbivorous Myriapoda, *Polydesmus granulatus*, and *Polydesmus virginensis*, I found two new and distinct species of entophyta, which I have referred to a different genus from *Enterobryus*, under the name of *Eccrina*, of which a description will follow hereafter.

Pursuing my researches after entophyta among insects next, I found none among the Hemiptera, nor the carnivorous Coleoptera, but in our most common, largest

herbivorous coleopterous insect, *Passalus cornutus*, resembling very much in its habits the *Julus marginatus*, and like it, living in decaying stumps of trees, I found a constant and most extraordinary profusion of vegetation, only equalled by that of *Julus marginatus*, among which was the third and very graceful species, the *Enterobryus attenuatus*.

1. *Of the Principal Cell of Enterobryus.*—(Pl. I. Fig. 1, *b*; 3, *b*; 4, *c*.) This is a very long, tubular, cylindrical cell, closed at the extremities. The end attached to the pedicle is set or received into a concavity, and is usually slightly dilated beyond the general diameter of the cell. (Pl. III. Fig. 11, *a*.) The distal end is usually more or less dilated or clavate and obtusely rounded (4), or it is abruptly truncated (17).

In *Enterobryus attenuatus* (Pl. I. Fig. 3) the cell is sometimes narrowed from the middle towards both extremities; at other times from the sigmoid flexure towards the distal end; but frequently is nearly uniform in its diameter throughout.

The cell-wall is amorphous in structure, thin, coriaceous, strong, flexible, very slightly elastic, perfectly transparent, usually colorless—always so in young specimens—frequently amber-colored, or yellowish or brownish, and occasionally dark brown. Its thickness is pretty uniform, except at the extremities, where it is rather thicker than at the sides. Its usual average is about the $\frac{1}{6000}$ of an inch.

In *E. attenuatus*, the cell-wall is sometimes twice as thick at the sigmoid flexure of the thallus as elsewhere; in the former position measuring the $\frac{1}{5000}$ of an inch, in the latter the $\frac{1}{10000}$ of an inch. When the distal extremity of the principal cell has no secondary ones attached, and is truncated, the cell-wall forming the margin of the extremity is increased in thickness sometimes to a triple extent, and occasionally projects beyond the general outline of the cell (Pl. III. Fig. 17, *d*). In these latter cases, the cell-wall forming the terminal face of the truncated extremity of the cell is sometimes so very thin that it appears as if the permanent cell-wall ceased at the margin of the extremity, and the internal, very delicate, transparent, colorless, mucoid bounding layer between the permanent cell-wall and the cell-contents, or the primordial utricle of Hugo von Mohl, protruded from the open end, resembling the crystal upon the face of a watch (Pl. II. Fig. 4, *b*; III. 7). Generally, however, it is observed that the cell-wall at the truncated extremity, though thin, is sufficiently strong to prevent the appearance described. In those cases in which the distal end of the principal cell of *Enterobryus* is clavate, with or without attached secondary cells, the cell-wall is thicker at that than at any other portion of the cell.

The cell-contents consist of a hyaline, or occasionally a faint amber-colored mucoid or albuminoid fluid, or protoplasma, with granules and globules of various sizes (Pl. III.).

It is only in the youngest individuals of *Enterobryus* that the principal cell usually contains a large quantity of the protoplasma. Ordinarily, at all more advanced ages, it is distended with fine and coarse granules and large globules, the intervals only being occupied by a relatively small proportion of protoplasma.

The granules are more or less minute, transparent, colorless, or occasionally faintly yellowish, spherical bodies, measuring from a mere point to the $\frac{1}{10000}$ of an inch in diameter (Fig. 10). They exist in variable quantity within the principal cell, usually more or less enveloping the globules, but never to such an extent as to exclude the latter, although they are themselves sometimes reduced to a few scattering points among a mass of globules. Usually, they are most abundant at the bottom or commencement of the cell (Figs. 6, 9), and rapidly diminish towards the distal extremity of the latter. Sometimes they are abundant at the bottom (Fig. 6), and do not exist at all near the distal end of the cell (Fig. 4); at other times they are found at both ends but none in the middle (Figs. 1–3); and lastly, they are occasionally met with towards the distal extremity of the cell only.

These granules somewhat resemble oleaginous particles in appearance; they are highly refracting, and are more dense than the surrounding protoplasma.

The globules, as I technically designate them, are colorless, transparent, spherical, polyhedral, or oblong bodies. When spherical, they are always accompanied by a more or less large quantity of protoplasma and granules (12). When polyhedral they exist in large number, and the form appears as an alteration from the spherical produced by mutual pressure (2, 14). When oblong, their long diameter is generally parallel to the length of the cell containing them, and ascends to three or four times that of the transverse diameter, which in such cases is always that of the caliber of the cell (Pl. II. 4; III. 8). Sometimes they are met with transversely oblong (2), the long diameter equal to the caliber of the cell, the short diameter always less than the latter, the form being apparently produced by upward pressure.

In size, the globules usually measure from one-sixth to the whole diameter of the caliber of the containing cell.

Sometimes they exist almost to the entire exclusion of the ordinary granular matter, or even the intervening protoplasma (Pl. II. 1; III. 2, 13, 14). Sometimes they are of remarkably uniform size in the same cell, though very variable in this respect in different cells (17); frequently, however, they vary very much in size within the same cell (Pl. II. 4). Occasionally, a single row of large globules distends the cell nearly throughout its whole length (Pl. III. 13); at other times, three or more rows are observed, polyhedral in form, regularly alternating with one another (17) through the whole course of the tube, if the latter remains uniform in diameter, or cylindrical; should the tube become clavate, or more dilated at the distal end, it is always attended by an increase in the relative number of globules (4).

In physical structure, the globules appear to be composed of a somewhat viscid, amorphous, hyaline, albuminoid liquid, inclosed within an immeasurably thin, amorphous membrane, apparently a delicate film of coagulated protoplasma, holding a mass of the same substance in a liquid condition.

Upon the application of a weak solution of iodine in water to the living thallus of *Enterobryus*, a movement is observed to take place in the contents of the principal cell in an upward direction, or towards the distal end, apparently as if the cell-wall were contracting, and there was less resistance anteriorly than posteriorly, and the cell-contents were consequently pushed in the former direction. A moment

after, however, the movement is reversed, the globules successively burst, and become at first faintly purplish, and afterwards brownish. The protoplasma and granules are colored a deep or intensely reddish brown.

With nitric acid, and the subsequent addition of aqua ammonia, the cell-contents become a confused mass of a beautiful amber color.

Solution of iodine, acetic acid, solution of chloride of sodium, aqua ammonia, or the long-continued action of water, give rise to a destruction of the different parts of the cell-contents, and causes a general shrinking of the mass from the inner surface of the cell-wall, the whole apparently held together by the continuity of the primordial utricle, which now presents a shrivelled, faintly granular appearance (IV. 2).

Occasionally, dead individuals of *Enterobryus* are met with in which the cell-contents are observed to have shrunk to two-thirds or even one-third their original extent, presenting a shrivelled, irregular, granulo-membranous appearance (Pl. IV. 1). The ordinary structural elements of the mass have disappeared, and in their place yellowish, globular, oil-like bodies are found of various sizes, from a granule up to one-fourth the diameter of the cell, occupying a position within, and exterior to, the shrivelled primordial utricular mass (1, *c*).

No circulatory movement of the character of cyclosis is ever observed in the cell-contents, nor can any molecular movement be perceived. Upon the rupture of a cell, however, and the escape of its contents, the finer granules exhibit slight movements of the kind just mentioned (Pl. I. 1, *f*).

2. *Of the Secondary Cells.*—(Pl. I. 1, *e*; 4, *d*.) In the fully developed *Enterobryus* there are usually two secondary cells; but occasionally there is only one, and very rarely there are even three.

In *Enterobryus attenuatus*, I have never been able to detect two secondary cells, and only in a few instances have I seen one; arising probably from the more rapid separation of these cells, after their development, in this species than in the others (Pl. III. 15, 16). A rapid separation of the secondary cells would also account for the truncated appearance of the distal extremity of the principal cell, and the great thinness of the cell-wall forming the truncated face, which is often observed in *Enterobryus attenuatus*, and but rarely relatively in the other two species (17).

Ordinarily, where two secondary cells exist, as in *Enterobryus elegans* and *Enterobryus spiralis*, they are oblong tubular, and the penultimate cell is usually a little longer, narrower, and more cylindrical than the terminal cell.

The latter is more or less cylindro-clavate, obtusely rounded at the distal end, and curved.

The contents of the secondary cells are of the same character as those of the principal cell. They generally contain a very much greater proportion of the granular matter than the principal cell, and frequently may be observed to be filled with granules to the exclusion of globules, the reverse of which I have never seen (Pl. I. 1).

When a third secondary cell exists, which I have observed in two or three instances among some thousands of filaments of *Enterobryus elegans*, two are alike,

and correspond to the description of the penultimate secondary cell above given, while the third is like the ultimate one described. When a single secondary cell exists in the last-mentioned species of *Enterobryus*, it has usually the same appearance as the terminal cell of those cases in which two are found.

In a half dozen instances only, among several thousand filaments of *Enterobryus attenuatus*, have I been able to detect the existence of a secondary cell. In some cases it was relatively very short and cylindrical, a trifling degree narrower than the principal cell, truncated at its free extremity, concave at the other, and fitting upon the convex termination of the principal cell, and entirely filled with granular matter. In others, the secondary cell was a very little broader or more bulging than the principal cell, longer than in the former instances, obtusely rounded at the free extremity, and filled with a hyaline protoplasma, with a few granules.

The connection of the secondary cells with the principal cell and with one another is very variable in its appearance in Enterobryus, and indicates that the former are derived from the latter by a process of division; or, in other words, it indicates at least one of the modes of reproduction of the plant to be by division.

The first indication of the separation of a secondary cell from the principal cell is a faint line corresponding to a plane passing transversely through the contents of the latter in the vicinity of its distal extremity (Pl. IV. 25, *c*). Examples are met with in which such a plane exists with the merest trace of a circumferential contraction of the primordial utricle at the edge of the plane without the slightest mark of such a character existing in the permanent cell-wall. The cell-contents above the plane of separation and for some distance below are always more or less granular, frequently to the total exclusion of globules, although these are frequently met with within the fully formed secondary cells.

In well developed principal cells of *Enterobryus* without attached secondary cells, the free extremity very generally is more or less filled or even distended with the characteristic globules, and is clavate in form (Pl. III. 4, 14), but when secondary cells are observed in their commencement, they are filled with granular matter (Pl. IV. 18, 21, 24), from which it appears the globules within the distal extremity of the principal cell are converted into granules in the development of the secondary cells.

I never observed this transformation step by step, but only saw the conditions which I have just described. In these cases, if the globules are really converted into granules, it is most probably not by the former being broken up into corresponding masses of the latter, but by a separation of granules more or less rapidly from the circumference of the globules; for when secondary cells are in course of development from the principal cell, the distal extremity of the latter always contains more or less granular matter enveloping the globules, which are spherical, and, relatively to those ordinarily found lower down, small in size.

Following the plane of division of the principal cell-contents in the production of a secondary cell, examples of *Enterobryus* are met with in which the circumferential contraction before mentioned, existing at the edge of the plane in the

primordial utricle within the permanent cell-wall, is deeper than in the former cases.

Next succeeds a distinct separation of the material which is to constitute the contents of the new secondary cell from that of the principal cell, and a thin transparent partition is formed, between the two portions, continuous at its outer margin with the enveloping primordial utricle (23, *c*).

It is not until this period that examples of the plant are found in which there exists an evident constriction in the permanent cell-wall corresponding to the margin of the partition separating the secondary from the principal cell. This constriction deepens, and continues to advance concentrically until it completely divides the thin transparent partition formed from the primordial utrical and separating the two distinct masses of cell-contents (19), and thus we have formed from the principal cell a perfect new or secondary cell. In the case of *Enterobryus elegans*, upon which the above observations were made, the distal extremity of the principal cell, after the complete development of secondary cells still remaining in connection with the former, is obtusely rounded, a little broader than the secondary cells, and appears to indicate that these continue their attachment some time after they are fully formed.

From the truncated appearance of the principal cell being observed so frequently in *Enterobryus attenuatus*, I suspect that the secondary cells, after their production, detach themselves very rapidly, giving rise to the watch-crystal-like appearance of the free end of the cell, from the thinness of the new membrane continuous at its circumference with the older, thicker, and stronger permanent cell-wall (Pl. III. 17).

In *Enterobryus elegans* and *Enterobryus spiralis*, the production of one secondary cell is rapidly followed, or even accompanied by another, developed from the principal cell. In rare cases, even a third cell commences its development from the principal cell before the detachment of the terminal cell.

3. *Of the Pedicle and Mode of Attachment.* (Pl. II. 4, *c;* III. 6, 9, 11, *b.*) The pedicle of attachment of *Enterobryus* is more or less cylindrical, solid, hard, transparent, amorphous in structure, yellowish or brownish in color, and faintly striated longitudinally. Its length varies with the age of the plant, and, to some extent, with the position of attachment.

In the youngest plants it looks like a very slight conical or mound-like elevation or thickening of the basement-membrane of the mucous membrane from which the plant grows (Pl. II. 3, *b*). It is colorless, and, in these cases, from its amorphous appearance, appears to be part of the structure of the basement-membrane.

As the principal cell grows in length the pedicle does so also, and, in a little time, appears quite a distinct structure from the basement-membrane to which it is attached. It reaches its greatest degree of development in *Enterobryus elegans*, and when the latter is attached to the exterior of entozoa, it becomes much longer than in the plants growing from the mucous membrane of the intestine in which the entozoa are found (Pl. VI. 6, *e;* 7, *d*). Upon an *Ascaris infecta*, I have observed individuals of *Enterobryus* with the pedicle the $\frac{1}{200}$ of an inch in length, while, in those

plants growing from the mucous membrane of the intestine it usually does not grow more than the $\frac{1}{400}$ of an inch in length.

In *Enterobryus attenuatus*, the pedicle is usually relatively shorter and broader, and more conoidal than in *Enterobryus elegans*.

In the latter, with the growth in length of the pedicle, it becomes more or less transversely contorted.

At its basis of attachment, the pedicle, when fully formed, is expanded into a discoidal surface, by which it adheres with very great tenacity to its body of support, so as to permit rupture of the pedicle, or the principal cell, without detachment of the former.

In the very young thallus of *Enterobryus*, the principal cell is situated upon the convex summit of its pedicle, but as the former grows and the latter increases in length, the summit of the pedicle becomes depressed, and receives the convex commencement of the principal cell in the manner of a ball and socket joint.

The attachment of the principal cell to its pedicle is strong, and it is much easier to break than to detach them from one another.

In *Enterobryus attenuatus*, in two instances, I observed the pedicle, twice its usual size, divided at the summit, and giving connection to two primary cells of the plant (Pl. IV, 27, *b*). These cases, of course, constituted an abnormal conjunction, such as is frequently observed throughout the vegetable and animal kingdom.

4. *State of Development of Enterobryus in relation to its particular Locality of Growth.*—The most favorable position for the development of *Enterobryus* is the commencement of the small intestine, or, more properly, the ventriculus of *Julus*, and the transverse ridges bounding the sacculi of the ventriculus of *Passalus*. In *Julus*, in the position mentioned, *Enterobryus* may always be found, and, in most cases, with secondary cells in all stages of development. In *Julus marginatus*, lower down in the ventriculus, *Enterobryus* is frequently met with, but always small in size, and but very rarely advanced to such a degree as to produce secondary cells. Within the large intestine of the same species of *Julus*, it may often be observed, more especially at the lower part, in the most extraordinary profusion, but always in the earlier stages of growth, rarely more than the sixth of a line in length, and forming a single, simple curved cell with faintly granular contents, and occasionally a few small globules (Pl. II. 2).

Enterobryus elegans is frequently found attached to any part of the exterior of the body of the nematoid entozoa of *Julus marginatus*, even upon the spiculate tail of *Streptostomum* or *Thelastomum*, which has a very little larger diameter than the plant itself (Pl. VI. 1, 2, 4–7; VII. 12, 15). Upon these worms I have never detected *Enterobryus* advanced to the stage of development of secondary cells, and its greatest length upon *Ascaris infecta* I found reaching to one line, but never so much upon the more active *Streptostomum agile* and *Thelastomum attenuatum*.

I never detected *Enterobryus attenuatus* growing upon *Hystrignathus rigidus*, a nematoid entozoon rarely absent from the ventriculus of *Passalus cornutus*.

5. *Advantage of the peculiar forms of different species of Enterobryus.*—One of the most beautiful instances of means adapted to an end in view is presented in the

form of *Enterobryus*. The plant is fixed upon the mucous membrane of the intestinal canal, in which it grows, and from its delicate structure it must be more or less constantly liable to rupture in the peristaltic movements of the bowels, and the passage onwards of the food; but from the spiral arrangement of the thallus of *Enterobryus elegans* and *Enterobryus spiralis*, and the sigmoid flexure of that of *Enterobryus attenuatus*, the graceful filiform plants may be elongated or stretched onwards for a considerable distance without danger of being torn. (See Pl. I.)

6. *Reproduction of Enterobryus.*—It is no doubt the case that *Enterobryus* is not only reproduced by segmentation, but also by spores, although in several thousand individuals of *Enterobryus elegans* which I have examined, in over one hundred and fifty individuals of *Julus marginatus*, from early spring until late in the autumn, I am not positively certain that I either observed the formation of the spores, or the development of the plant from the spore.

The earliest condition in which I have been able to detect *Enterobryus elegans*, was in the form of a delicate, transparent, colorless, globular, oval, or ovate vesicle, measuring the $\frac{1}{2500}$ of an inch in diameter, or almost the $\frac{1}{1250}$ of an inch long, by the $\frac{1}{1888}$ of an inch broad (Pl. IV. 3). The contents consisted of a colorless protoplasm. When elongated, the poles of the parietes were thickened, and one end was adherent to the mucous membrane of the viscus in which these bodies were found.

In the next stage, the young *Enterobryus* had the form of a delicate, colorless, oblong, oval cell, the $\frac{1}{1000}$ of an inch long by the $\frac{1}{2300}$ of an inch broad, filled entirely with a faintly granular substance; or in other instances, with a mixture of this and globules, or with globules alone, attached by one extremity to a slight conoidal, pedicular elevation, arising from the surface of support (4–6). From this period, as it advances in its development, it is usually disposed to grow in a cylindroid, curved, clavate form, in which state it may be frequently met with from the size above given to the $\frac{1}{150}$ of an inch in length (8, 10). Having reached the latter point, it becomes more cylindrical, and up to the $\frac{1}{75}$ of an inch in length is disposed to grow into a single spiral coil (11).

Generally the cell-contents, from the earliest condition above mentioned, become almost wholly globular; but within the rectum of *Julus marginatus*, the contents of the plant-cells retain their granular appearance, occasionally with a very few globules, until the latest period in which I have observed them.

Occasionally, the young thallus of *Enterobryus elegans* grows to $\frac{1}{75}$ of an inch in length, perfectly straight, cylindro-clavate in form, and filled with globules (13, 14). Less frequently, it is found constricted somewhere near the middle of its length, the distal portion broader than the attached (15). More frequently than in the two last cases, it is found having a sort of geniculate bending at an obtuse angle in some part of its course, usually below the middle, but occasionally above it, with the distal portion possessing a greater diameter than the lower portion, which is straight, while the former is often curved, occasionally recurved, though sometimes also straight (17).

The young of *Enterobryus attenuatus* I observed growing within the ventriculus of the larva of *Passalus cornutus*, from the $\frac{1}{466}$ of an inch to the $\frac{1}{116}$ of an inch in

length, cylindrical, and straight or gently curved. Very frequently it presents a slight geniculate bend, occupying a position generally above the upper fourth or fifth of the thallus, the distal portion being straight or slightly curved, and, most commonly, narrower than the lower portion, the reverse of what is observed in the young of *Enterobryus elegans*. The contents usually consist of globules.

The next entophyte, to which I shall direct especial attention, I have named *Eccrina*, a genus closely allied to *Enterobryus*, to which, probably, most naturalists would refer it, but which I was led to consider as distinct, first, in the case of *Eccrina moniliformis*, which at the distal extremity of the thallus produces a very great number of globular secondary cells. The *Eccrina longa*, originally described as a species of *Enterobryus*,[1] from its also producing numerous secondary cells, though not globular, I afterwards preferred assigning to *Eccrina*.

§ 5. Description of the Genus and Species of Eccrina.

ECCRINA, Leidy.

Thallus attached, consisting of a single very long tubular cell, filled with granules and globules, producing at its free extremity a succession of numerous globular or oblong cells, and growing at the other end from a relatively short, cylindroid, amorphous, coriaceous pedicle, commencing with a discoidal surface of attachment.

1. Eccrina longa, Leidy.

Proc. Acad. Nat. Sci., v., 35.

(Plate V. Figs. 1–13.)

Thallus long, filiform, colorless, or brownish, transparent, cylindrical, usually not holding a constant relation of breadth to the length, forming a simple curve or single spiral turn, and then proceeding in a straight line or gently flexuose curve to the free extremity. *Pedicle* very short, columnar, expanded at the base. *Principal cell* very long, uniformly cylindrical. *Secondary cells* in various stages of development from ten to thirty in number, oblong, or short cylindrical, with obtusely rounded extremities when completed.

Whole length from 2 to 7 lines. Length of pedicle $\frac{1}{3000}$ to $\frac{1}{1500}$ of an inch. Breadth of principal cell, from $\frac{1}{2000}$ to the $\frac{1}{517}$ of an inch. Length of secondary cells, from the $\frac{1}{525}$ to the $\frac{1}{350}$ of an inch.

Habitation. Parasitic, growing in profusion from the mucous membrane of the posterior part of the intestinal canal of *Polydesmus virginiensis*.

[1] Proc. Acad. Nat. Sci., vol. v., p. 9.

2. Eccrina moniliformis, Leidy.

Proc. Acad. Nat. Sci., v., 35.

Thallus colorless or ambreous, transparent, growing in a double or triple spiral. *Pedicle* short. *Principal cell* cylindrical. *Secondary cells* in various stages of development, from 20 to 50 in number, globular when fully formed.

Whole length, from 1 to 1½ lines. Breadth of principal cell $\frac{1}{1500}$ of an inch. Diameter of secondary cells, from the $\frac{1}{1875}$ to the $\frac{1}{1500}$ of an inch.

Habitation. Parasitic, growing from the mucous membrane of the intestinal canal of *Polydesmus granulatus.*

§ 6. History, Structure, etc. of Eccrina.

The genus *Eccrina* I have not had an opportunity of studying with as much care as *Enterobryus*, simply because the animals in which it is parasitic are not so abundant in the neighborhood of Philadelphia as the species of *Julus.* When I first discovered *Eccrina moniliformis*, I took notes of its appearance, but deferred figuring it until a more favorable opportunity, which, however, has not yet arrived; for I have since not been able to find any other than the young of *Polydesmus granulatus*, in which the entophyte, not constantly existing, does not present the fully developed condition.

To my friend, Professor Baird, then of Carlisle, Pennsylvania, now of the Smithsonian Institution, Washington, I am indebted for numerous individuals of *Polydesmus virginiensis*, from which I obtained materials for figures and full descriptions of *Eccrina longa.*

This species is remarkable on account of its very great relative length, not only to the other entophytes described, but also to the animal in which it is parasitic.

The principal cell in both species of *Eccrina* is almost uniformly cylindrical throughout, and in *Eccrina longa*, at its lower part, makes a long sigmoid flexure, or single spiral turn, as in *Enterobryus elegans*, while in *Eccrina moniliformis*, in union with its secondary cells, it usually makes a double or triple spiral, as in *Enterobryus spiralis.*

The breadth of *Eccrina longa* is not so uniform as that of *Eccrina moniliformis*, or the different species of *Enterobryus*, nor does it usually correspond to the length. Thus, I have observed filaments 4 lines in length, the $\frac{1}{1000}$ of an inch in diameter; filaments of 5 lines, the $\frac{1}{575}$ of an inch; a few of 3 lines, only the $\frac{1}{2500}$ of an inch, &c.

Eccrina is the most remarkable of the entophyta which I have discovered, because a full-grown individual exhibits at one view the process of multiplication of cells by division in the most gradual state of progression.

1. *Of the Principal and Secondary Cells.*—(Pl. V. 1–6.) The description of these two kinds of cells must be given together, as the contents in the distal extremity of the one pass gradually into the construction of the other.

The cell-contents consist of the same materials and in the same varying character as in *Enterobryus*, except in full-grown individuals, in which, at the distal extremity,

they are generally granular, often to the exclusion of globules, and are divided into distinct masses in the course of development into secondary cells.

In *Eccrina longa*, the secondary cells in their origin are first observable as relatively short cylindrical divisions of the cell-contents within the distal extremity of the principal cell (3). Their number does not always correspond with the length of the thallus. Thus, I have observed filaments $3\frac{1}{2}$ lines long, with 25 secondary cells; others of 6 lines, with from 12 to 20; some of 7 lines, with from 16 to 30, etc. Nor is the length of the secondary cells uniform, nor in relation with that of the thallus (1–4). They vary in the same and in different individuals in this respect. In some individuals they are found increasing in length successively from the first to the last, indicating a continuance of growth during the process of development by division from the primary cell. Thus, in an individual of 6 lines in length, with 24 secondary cells, the first measured the $\frac{1}{600}$ of an inch in length, by the $\frac{1}{855}$ of an inch in breadth, and the others very gradually increased in length, but diminished slightly in breadth to the last, which measured $\frac{1}{350}$ of an inch in length by the $\frac{1}{1111}$ of an inch in breadth. In another individual, 5 lines in length with 12 secondary cells, these were nearly uniform, measuring from $\frac{1}{250}$ to $\frac{1}{300}$ of an inch in length by $\frac{1}{750}$ of an inch in breadth. In another, of $4\frac{1}{2}$ lines with 16 cells, they all measured $\frac{1}{1855}$ of an inch in length by $\frac{1}{880}$ of an inch in diameter. In another, of 7 lines with 25 secondary cells, the first measured $\frac{1}{300}$ of an inch in length, the fourth only $\frac{1}{533}$ of an inch, and the last $\frac{1}{375}$ of an inch.

The contents of the secondary cells, from their earliest condition, are uniformly granular (1, *c*; 2, *b*; 3, *b*; 4, *a*), and in mass appear white and opaque. The granules are distinct, spherical, transparent, and colorless, and measure from $\frac{1}{1500}$ to $\frac{1}{7500}$ of an inch in diameter. I never observed globules within the attached secondary cells, but have seen them within those which have become detached, which will be again referred to (6, *a*).

The contents of the primary and secondary cells and the cell-wall, conduct themselves, upon the application of chemical reagents, in the same manner as *Enterobryus*.

In the progressive formation of secondary cells, the first step is the division of the contents within the distal extremity of the primary cell into separate cylindrical masses.

At the circumference of the planes of division, a constriction of the primordial utricle is very early observable, and sometimes a constriction of the permanent cell-wall rapidly follows or is almost coexistent, but frequently it does not form until a late period, as in *Enterobryus elegans*.

Upon the segmentation of the contents within the distal extremity of the primary cell in the formation of secondary cells, the inner surface of the permanent cell-wall appears to become combined or continuous with an extremely thin and delicate membranous layer occupying the planes of separation of the cylindrical, granular cell-masses, which I suspect is derived from the primordial utricle, or preferably from the coagulation of a portion of protoplasma, which has exosmosed from the interior of the cell-masses, each inclosed within a distinct sac of the primordial utricle, into the interspace at their extremities. This, I say, I suspect to be the mode of origin of the partition continuous with the permanent cell-wall between

the secondary cells; for when the cell-masses, at an early period of their division, are made to shrink from one another by the application of acetic acid, an exceedingly delicate, but entire membranous partition is observable, or none at all; and in no instance could I detect a concentric growth from the inner surface of the permanent cell-wall ultimately intended to separate the cell-masses. After the formation of the membranous partition described, the permanent cell-wall at the boundary of the former becomes constricted, and the secondary cells are apparently completed by a splitting of the membranous partition through the advancing constriction of the permanent cell-wall.

Before complete division of the secondary cells, the permanent cell-wall at the margin of its constriction above and below, is somewhat thickened (2 *c*), but afterwards again assumes the general thickness, and the two portions of the divided partition between the secondary cells are thickened to the extent of the lateral portion of the cell-wall. Frequently, the secondary cells become detached before the cell-wall at the end has become as thick as it exists laterally, and in such cases the circumference of the extremity is indicated by a thickened annulus of the cell-membrane, while that portion of the latter included within the area of the annulus, resembles the crystal upon the face of a watch (4, *a*); an appearance, as before stated, frequently observed at the free extremity of the primary cell of *Enterobryus attenuatus*, and of *Enterobryus elegans*.

The course of development of the secondary cells of *Eccrina moniliformis* is the same exactly as that of *Eccrina longa*. It is, however, more striking, from the extraordinary number of cells involved in the process, which exhibit a very gradual progression from the earliest stage to the fully-developed cells. In this species the early divisions of the cell-contents within the distal extremity of the primary cell are transversely oblong, but soon assume the globular form as they successively approach the free end of the thallus.

The secondary cells of *Eccrina*, in all their stages, uniformly possess granular contents.

2. *Of the Pedicle of Eccrina.*—This has the same structure and mode of attachment as in *Enterobryus*, but it is always relatively very short.

3. *Of the Position of Growth.*—I have found *Eccrina* growing only from the mucous membrane of the ventriculus of *Polydesmus virginiensis* and *Polydesmus granulatus*, especially at its commencement, in which position it reaches its most perfect development. I never detected *Eccrina longa* growing upon *Thelastomum labiatum*, an entozoon of *Polydesmus virginiensis*.

4. *Of the Development.*—As in the case of *Enterobryus*, I have never been able to observe the process from the spore, but have traced it from a very early condition, most probably derived from the latter, and also from the secondary cells detached from the parent plant.

Detached secondary cells of *Eccrina longa*, are not unfrequently observed intermingled with the growing filaments of the mother plants. The form of these detached cells is like those at the free end of the row of secondary cells still attached but ripe for separation, that is, oblong, or short cylindrical, with obtusely rounded extremities. They are filled with uniform granular contents, as in the attached

cells, or they are found filled with a fainter granular matter and more protoplasm, apparently as if much of the original granular matter had undergone solution, and less frequently some are observed containing granular contents mixed with globules.

The secondary cells do not always become detached singly from the parent plant, for I have occasionally observed two and three clinging together by their extremities, but separated from the parent (6).

The detached cells exhibit a remarkable disposition to reattach themselves by one extremity, usually to the mucous membrane of the intestinal canal; but, in several instances, I have observed them attached to the sides of a growing thallus (5 *c*). The law which determines the detachment of the secondary cells from the parent plant, to become again attached to some other body is curious and difficult to understand.

Besides detached secondary cells, more frequently young growing thalli of *Eccrina* are observed, remarkable for their singular form. These consist of a primary cell from the $\frac{1}{500}$ of an inch to the $\frac{1}{4}$ of a line in length, with an abrupt geniculate bend in some part of its course, the upper and lower portions forming a more or less obtuse angle with each other (8, 9, 11, 13). The portion below the flexure is cylindrical and usually straight, but occasionally is slightly curved, or sigmoid, and measures from $\frac{1}{5000}$ to $\frac{1}{1500}$ of an inch in diameter. The upper or distal portion is more or less dilated, cylindroid, straight, obtusely round at the end, and measures from the $\frac{1}{3000}$ to the $\frac{1}{750}$ of an inch in diameter.

The bend or flexure occurs at any point below the distal third of the thallus. Sometimes the lower portion of the latter is twice as long as the upper, when it looks like an oblong cell supported upon a long footstalk (13); in other cases, the upper portion is four or five times longer than the lower (12).

Occasionally, the young thallus observes a straight course throughout, and is clavate in form (10).

The contents of the young filaments of *Eccrina* consist of protoplasma with faintly granular matter (12), or the same combined with a few globules (10), or the lower portion of the cell is filled with the former, and the upper portion with the latter (8, 11); or, in rather older individuals, the upper portion is frequently distended with globules, while the lower contains a mixture of granules and globules passing gradually into a mass of protoplasma at the lower extremity (13), or the whole, in still more advanced individuals, is entirely filled with globules with a very few granules and a small quantity of intervening protoplasma (7).

The attachment of the young of *Eccrina*, like that of *Enterobryus*, is upon a slight conical elevation, apparently part of the structure of the basement-membrane.

§ 7. Description of the Genus and Species of Arthromitus.

ARTHROMITUS, Leidy.

Proc. Acad. Nat. Sci., iv., 227.

Thallus attached by means of one or more granules, simple, cylindrical, very long, filamentous, articulate, without ramuli. *Articuli* indistinct, with amorphous contents finally converted into solitary oval sporuli.

1. Arthromitus cristatus, Leidy.

Proc. Acad. Nat. Sci., iv., 227.

Arthromitus nitidus, Leidy: ibid., v., 35.

(Plate II., Fig. 1, *i*; V. 3, *d*, 14, 15; VI. 5 *e*; VIII. 1 *f*, 2 *d*, 3, 4, 5.)

Thallus very delicate, filamentous, linear, straight or inflected, flexible, colorless, translucent, obtusely rounded at the free end. *Pedicle* of attachment one or more amber-colored round or oval granules. *Articuli* indistinct, but becoming well-marked after the development of the interior sporular body. *Spore* oval, simple, faintly yellowish, translucent, highly refractive, usually lying oblique and alternating in position in different articuli. Length from the $\frac{1}{1500}$ to the $\frac{1}{12}$ of an inch. Breadth about the $\frac{1}{1625}$ of an inch.

Habitation. Parasitic, grows from the mucous membrane of the ventriculus and large intestine of *Julus marginatus*, and also upon *Enterobryus elegans*, *Ascaris infecta*, *Streptostomum agile*, and *Thelastomum attenuatum*; from the mucous membrane and its appendages of the ventriculus of *Passalus cornutus*, and *Polydesmus virginiensis*, and upon *Eccrina longa*.

§ 8. History, Structure, etc. of Arthromitus.

The genus *Arthromitus*, I first detected growing within the ventriculus of *Julus marginatus*. Some time subsequently, I detected much larger filaments of the same plant, with relatively very distinct articuli, growing within the large intestine of the same animal, which I supposed to be a distinct species from the former, and, therefore, described it as such under the name of *Arthromitus nitidus*. Since then, within *Julus marginatus*, *Passalus cornutus*, and *Polydesmus virginiensis*, I have observed *Arthromitus* under a variety of conditions, and in all gradations of size and development, from the simple, exceedingly minute, inarticulate filament, to a length of one line, with distinct articuli; and therefore I cannot, at present, distinguish more than one species; and for this, the name is retained which was first proposed.

As just stated, I have observed this entophyte from the condition of an exceedingly minute, delicate, inarticulate filament to a thallus one line long, and distinctly articulate, and containing within very many of the articuli, sporular bodies.

Frequently, there may be detected, growing with the undoubted thallus of *Arthromitus*, filaments of the former character; simple, hyaline, and inarticulate, as short as the $\frac{1}{3000}$ of an inch, as long as the $\frac{1}{50}$ of an inch, and not more than the $\frac{1}{3300}$ of an inch in diameter. With these are intermingled filaments, very faintly articulated, measuring up to the $\frac{1}{12500}$ of an inch in diameter.

Within the ventriculus of *Julus marginatus*, this entophyte, when fully developed, measures from the $\frac{1}{500}$ to the $\frac{1}{300}$ of an inch in length, by the $\frac{1}{20000}$ to the $\frac{1}{12500}$ of an inch in diameter.

Within the large intestine of the same animal, *Arthromitus* appears to reach its

greatest degree of perfection, attaining dimensions of one line in length by the $\frac{1}{5}\frac{1}{2}\frac{1}{0}\frac{1}{0}\frac{1}{0}$ of an inch in breadth, with remarkably distinct articuli (Pl. V. 14, 15).

Within the ventriculus of *Passalus cornutus*, filaments of the plant often acquire a length of $\frac{1}{4}$ of a line, and occasionally even of a $\frac{1}{2}$ line, with a diameter of the $\frac{1}{1}\frac{1}{1}\frac{1}{0}\frac{1}{0}\frac{1}{0}$ of an inch.

The articuli of *Arthromitus*, excepting when they contain spores, are usually indistinct, arising apparently from the general amorphous character of the contents which have the same or very nearly the same refrangibility as the cell-wall. Their average dimensions are the $\frac{1}{1}\frac{1}{0}\frac{1}{0}\frac{1}{0}\frac{1}{0}$ of an inch in length by the $\frac{1}{1}\frac{1}{6}\frac{1}{2}\frac{1}{5}\frac{1}{0}$ of an inch in breadth. In the variety which grows within the large intestine of *Julus marginatus*, the articuli are about the length of the diameter of the filaments, or a very little longer. In that of *Passalus cornutus*, they average the $\frac{1}{1}\frac{1}{2}\frac{1}{5}\frac{1}{0}\frac{1}{0}$ of an inch in length.

The filaments of *Arthromitus* are cylindrical, and only depart from this general form in the very slight dilatation which often exists in the articuli, giving them a keg-shaped appearance. The contents of the thallus are always amorphous and hyaline, never having even the faintest appearance of granules.

Not unfrequently, in the largest variety of *Arthromitus*, several articuli along the course of the thallus are contracted into a solid columnar form, not more than half the diameter of the others (14, *c*).

1. *Of the Spores of Arthromitus.*—These are always observed single within the articuli. Most frequently, they exist only in the articuli which form the distal portion of the thallus, but they are also often seen in any part of the length of the latter, sometimes at intervals of a variable number of articuli containing none; and occasionally, they exist in all the articuli.

In the largest variety of *Arthromitus*, in which the character of the sporuli is best observed, the articulations which contain them are slightly contracted, or have a little less diameter than the others (15, *b*).

The position of the sporuli is usually oblique, and they alternate in this direction in the different articuli; frequently, they are arranged longitudinally, never transversely. They are elliptical in form, transparent, highly refracting like oil-globules, of a light amber-color, and are amorphous in structure. On the average, they measure the $\frac{1}{1}\frac{1}{2}\frac{1}{0}\frac{1}{0}\frac{1}{0}$ of an inch in length, by the $\frac{1}{2}\frac{1}{2}\frac{1}{0}\frac{1}{0}\frac{1}{0}$ of an inch in breadth. In the *Arthromitus* of *Passalus cornutus*, they measure the $\frac{1}{1}\frac{1}{0}\frac{1}{0}\frac{1}{0}\frac{1}{0}$ of an inch in length, by the $\frac{1}{2}\frac{1}{5}\frac{1}{0}\frac{1}{0}\frac{1}{0}$ of an inch in breadth. In the largest variety of the plant, they measure the $\frac{1}{7}\frac{1}{0}\frac{1}{0}\frac{1}{0}\frac{1}{0}$ of an inch in length, by the $\frac{1}{1}\frac{1}{2}\frac{1}{5}\frac{1}{0}\frac{1}{0}$ of an inch in breadth.

2. *Of the Development of the Spores.*—This is most readily observed within the articuli of the largest variety of *Arthromitus* growing within the large intestine of *Julus marginatus* (14, 15). The sporuli appear to originate in a gradual contraction, condensation, and consolidation of the protoplasmoid contents of the articulations. Within these, may frequently be observed single oval or clavate, or bent oval or reniform masses, faintly outlined, and nearly filling their cavity (15, *a*). The masses gradually contract to the bulk of the spores, and become distinct, shining, and highly refracting, and in this condition constitute the fully-developed sporuli (*b*).

3. *Of the Mode of Attachment of the Thallus.*—Although the attachment of *Arthromitus* is very firm and tenacious, yet the thallus possesses no pedicle like that of *Enterobryus* and *Eccrina*, but grows from granular bodies resembling those upon which the algoid filaments of the human teeth, and those of other animals, are based.

The granules of attachment, from which a few filaments start, are often single or isolated; but usually there is an aggregation of several granules, from which grow more or less dense bunches of the plant (3, *e;* 14, *a;* VIII. 5). The granules adhere to their basis of attachment as if cemented. They measure from the $\frac{1}{20000}$ to the $\frac{1}{16000}$ of an inch in diameter; usually appear globular in form, and are amorphous and amber-colored, and refract light as highly as oil-globules.

4. *Of the Particular Locality and Mode of Growth.*—*Arthromitus* may be found in at least 90 per cent. of cases, within the ventriculus of *Julus marginatus*, ranging from single isolated filaments to very dense bunches. It grows, in company with *Enterobyrus elegans*, from the mucous membrane, especially near the commencement of the organ. When in bunches, or tufts, the filaments spread or radiate from their central granules of attachment, like a dense tassel held upwards. Occasionally, the bunches are found closely twisted, with their filaments intertwined and plaited, forming columns, from the $\frac{1}{3000}$ to the $\frac{1}{12500}$ of an inch in diameter, spreading at the summit.

Arthromitus is frequently found growing upon *Ascaris infecta*, *Streptostomum agile*, and *Thelastomum attenuatum*, upon any part of the exterior surface, but most usually from the lips of the anal and generative apertures, or the interspaces of the annuli of the body; these, apparently, being the most favorable resting-places for the sporuli from which the filaments are developed.

It is also frequently found growing in great profusion upon *Enterobryus elegans*, often in dense bunches, covering its summit (Pl. III. 12), or in a number of concentric circles on any part of its length, or radiating from particular points (Pl. VI. 1, *h*). A favorite locality for its growth, upon this species of *Enterobryus*, is the basis of attachment of the pedicle of the latter, or the junction of this with the primary cell. The youngest individuals of *Enterobryus* are sometimes so completely covered with *Arthromitus* as to be entirely obscured or hidden from view (Pl. IV. 16, *c*).

As before mentioned, *Arthromitus* reaches its highest degree of development in the large intestine of *Julus marginatus;* a curious fact, when we recollect that *Enterobryus elegans*, although growing here in greater profusion than in the ventriculus, never advances to the formation of secondary cells. In the same relation to quantity as we find *Enterobryus*, with its state of development in the two cavities mentioned, so we also find that *Arthromitus*, with its greater degree of perfection in the large intestine, does not grow in dense bunches, as in the ventriculus, but in a very small number of filaments associated together, frequently in pairs; two, four, or eight, often single, very rarely more than eight together.

I have never observed *Arthromitus* to be parasitic upon the entozoa or *Enterobryus*, within the large intestine of *Julus marginatus*. *Arthromitus* is found within the ventriculus of *Polydesmus virginiensis*, but not in the profusion in which it occurs in

Julus marginatus. It is also not unfrequently found parasitic upon *Eccrina longa*, growing in the same manner as upon *Enterobryus elegans.*

Within the ventriculus of *Passalus cornutus*, it grows from any part of the surface, not so abundantly as in *Julus marginatus;* but, nevertheless, profusely from the hair-like appendages of the cavity, or from the mucous membrane forming the doublings separating the sacculi of the stomach.

I never observed it parasitic upon *Enterobryus attenuatus.*

§ 9. Description of the Genus and Species of Cladophytum.

CLADOPHYTUM, Leidy.

Thallus attached by means of one or more granules; filamentous, simple, with minute lateral ramuli, or branched, inarticulate, amorphous in structure.

1. Cladophytum comatum, Leidy.

Proc. Acad. Nat. Sci., Phila., iv., 227.

Cladophytum ramosissimum, Leidy: Ibid., iv., 250.

(Plate II. Fig. 1 *h;* Pl. IV. Figs. 27 *d*, 28 *f;* Pl. V. Figs. 3 *f*, 14 *e;* Pl. VI. Fig 7 *f;* Pl. VIII. Figs. 1 *d*, 2 *c*, 6, 7, 8.)

Thallus very delicate, linear, colorless, simple, with very minute ramuli, or very much branched, with minute ramuli upon the terminal branches. *Pedicle* of attachment one or more, amber-colored, spherical, amorphous granules. Length from the $\frac{1}{800}$ to the $\frac{1}{75}$ of an inch.

Habitation.—Parasitic, in the same positions with *Arthromitus.*

§ 10. History, Structure, etc. of Cladophytum.

In the preceding description, I have included what I formerly considered to be two distinct species of *Cladophytum*, as I have since observed a variety of intermediate forms which indicate them to be the same.

Cladophytum is the most minute of the entophyta which I have distinctly observed. It is very heteromorphous in its character, and there may probably be several species; but the power of the microscope in its present condition is not sufficient to characterize them.

It always appears colorless, branching, and entirely amorphous in structure.

Frequently, it is found consisting of simple filaments, with minute simple ramuli from the $\frac{1}{700}$ to the $\frac{1}{100}$ of an inch in length, by the $\frac{1}{3000}$ to the $\frac{1}{25000}$ of an inch in diameter, growing in more or less dense bunches or tufts (Pl. VIII. 6). The ramuli do not measure more than the $\frac{1}{8000}$ to the $\frac{1}{70000}$ of an inch in length. It is also commonly observed, more or less branching, from the $\frac{1}{300}$ to the $\frac{1}{75}$ of an inch in length (Pl. V. 3, *f;* 14, *e*). The branches are about the $\frac{1}{150000}$ of an inch in

diameter, and are provided with very minute, oblique ramuli, about the $\frac{1}{3000}$ of an inch in length (Pl. VIII. 7).

The thallus of *Cladophytum*, even at the conjunction of the branches, never presents the slightest trace of articulation.

Of the development of this plant, or the formation of its spores, I could detect nothing.

Its mode of attachment is the same as that of *Arthromitus*.

The granules of attachment measure from the $\frac{1}{7500}$ to the $\frac{1}{2500}$ of an inch, and often exist in masses the $\frac{1}{600}$ of an inch in diameter.

Cladophytum grows in all the positions in which *Arthromitus* is found, and the smallest variety of the former is sometimes observed even growing upon the largest variety of the latter. It is found in the most extraordinary profusion within the ventriculus of *Pussalus cornutus*, attached to the mucous membrane and its hair-like appendages, (Pl. VIII. 1; IX.)

§ 11. Description of the Genus and Species of Corynocladus.

CORYNOCLADUS, Leidy.

Thallus attached by means of one or more granules; filamentous, very compound; branches thicker than the trunk, without ramuli; inarticulate, amorphous in structure.

Corynocladus radiatus, Leidy.

Proc. Acad. Nat. Sci., Phila., iv., 250.

(Plate VIII. Fig. 1 *e*; IX. Fig. 2 *e*; X. Figs. 1, 2.)

Thallus solitary, or growing in more or less dense bunches. Trunk or main stem relatively narrow, variable in length, either dividing shortly after its origin into several principal branches, which subdivide into numerous others, many times longer and thicker than the trunk, and cylindro-clavate in form, and obtusely rounded at the extremities, or gradually subdividing into numerous cylindro-clavate branches, thicker but not longer than the trunk.

Maximum length the $\frac{1}{60}$ of an inch. Breadth of trunk from the $\frac{1}{1500}$ to the $\frac{1}{1250}$ of an inch in diameter. Branches $\frac{1}{600}$ to the $\frac{1}{140}$ of an inch in length, by the $\frac{1}{7000}$ to the $\frac{1}{6000}$ of an inch in breadth.

Habitation.—Parasitic, observed only growing from the mucous membrane and its appendages of the ventriculus of *Pussalus cornutus*.

§ 12. History of Corynocladus.

I have never observed the development of this entophyte, nor anything certain in regard to the formation of its spores, although I have noticed a frequent appearance of a faint granular substance adhering to the exterior of the clavate branches, which, under a power of 600 diameters, is indistinctly resolved into the form of elliptical masses, resembling sporules (Pl. X. 2).

§ 13. On some Parasitic Phytoid Bodies, the nature of which is obscure.

Among the objects which I detected with a good deal of constancy within the ventriculus of *Passalus cornutus*, is one which has puzzled me exceedingly. It is an elongated tubular cellule, attenuated at both ends, which I formerly described, probably too hastily, as an entophyte, under the name of *Cryptodesma*.[1] Up to the present time, I have not been able to satisfy myself of its true character; whether it be really an entophyte, or only the epithelial cells of the ventriculus, elongated by endosmosis (Pl. X. 3). One would suppose it to be an easy matter to resolve this question, but there are many difficulties in the way of its determination. Its constancy of existence is no objection to its entophytic character, for certain undoubted entophytes, as *Enterobryus attenuatus*, *Arthromitus*, and *Cladophytum*, and an entozoon, *Hystrignathus rigidus*, are quite as constant in their existence.

The epithelial cells of the mucous membrane are ordinarily in the form of columnar prisms. The bases of attachment of these I have often very distinctly observed through the translucent basement-membrane from the exterior; but their sides, even at the edge of a section of the mucous membrane, I could never satisfactorily examine, on account of their being totally obscured by the vast profusion of *Arthromitus*, *Cladophytum*, and *Corynocladus;* more particularly, however, by a peculiar vegeto-granular substance, growing everywhere from the surface of the membrane. In the larva of *Passalus*, these cells can readily be distinguished, and in this they are observed to be prismoid, and are not altered by the endosmosis of water, so as to assume the form of the phytoid cells in question. These latter were always seen detached, usually in groups, or adhering to masses of granular matter, but were never observed attached to the hair-like appendages of the mucous membrane.

In structure, they resemble more the cellules of a fungous mycelium, than the algoid plants previously described, consisting of a delicate tubular cell, usually somewhat irregular, and inclosing very finely granular contents. Acetic acid does not dissolve them, nor does it destroy the appearance of epithelia observed through the basement-membrane.

I have examined numerous individuals of *Passalus*, to ascertain the true nature of the bodies described, and sometimes almost concluded they were entophytic parasites; at others, that they were really elongated epithelial cells; and, for the present, I leave the subject, with the intention of investigating it more closely and patiently at a future time.

In addition to the entophyta described in the preceding pages, which inhabit the alimentary canal of *Julus marginatus* and *Passalus cornutus*, there is also found within the ventriculus of these animals a peculiar phytoid substance, which is worthy of attention.

The surface of the mucous membrane of the ventriculus of *Julus marginatus*, is

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[1] Proc. Acad. Nat. Sci., Phila., iv., 250.

very generally studded, at irregular intervals, with circular or oval plano-convex patches, from the $\frac{1}{3000}$ to the $\frac{1}{214}$ of an inch in diameter, and the $\frac{1}{7500}$ to the $\frac{1}{14285}$ of an inch in thickness, composed of an exceedingly fine granular substance, yellowish or brownish in color (Pl. VIII. 2, *a*). When the patches are larger, they are more or less lobulated at the circumference, and have the appearance of being composed of several smaller ones which have run together.

These patches do not originate in a mere deposit of particles of food upon the mucous membrane; and though not composed of organic cells, or their transformations, but only of the minutest granules, measuring from the $\frac{1}{50000}$, or even less, to the $\frac{1}{20000}$ of an inch in diameter, yet their character is phytoid. Truly parasitic, they firmly adhere to the mucous membrane, and increase in breadth by growth at the edges. The latter, from their thinness, give the appearance to the patches as if they possessed a distinct translucent border.

Sometimes the patches have a faintly radiated appearance, which is especially distinct at the translucent margin.

Besides these patches, there not unfrequently exist irregularly oval or ovate bodies attached to the mucous membrane, amorphous in structural appearance, translucent, of a deep-amber color, and measuring from the $\frac{1}{1500}$ to the $\frac{1}{375}$ of an inch long, by the $\frac{1}{3000}$ to the $\frac{1}{4285}$ of an inch in breadth (*b*). These bodies often become the nucleus of growth of the granulo-phytoid patches, and either or both form a favorable nidus of attachment to *Arthromitus* and *Cladophytum*. None are ever observed growing upon the exterior of the nematoid entozoa, infesting the ventriculus of *Julus marginatus*.

Within the ventriculus of *Passalus cornutus*, the hair-like appendages, which everywhere cover the surface of the mucous membrane, are constantly more or less enveloped in a granulo-filamentous phytoid substance. As in the case of the phytoid patches of the ventriculus of *Julus marginatus*, this substance is not a mere deposit of particles of food, but a regular parasitic growth (Pl. VIII. 1, *c*; IX. 2, *c*). Upon the long hairs (Pl. VIII. 1, *b*), which fringe the transverse folds between the ventricular sacculi, this matter accumulates to the thickness of from the $\frac{1}{3000}$ to the $\frac{1}{4285}$ of an inch. When a mass is compressed, it has a faintly radiated appearance from the centrally inclosed hair.

The color of this peculiar phytoid substance is ochreous yellow, passing into brownish at the surface of the masses (Pl. IX. 2, *c*).

Frequently, it is observed accumulated upon the summit, or upon any part of the length of the hairs (Pl. IX. 2), into round or oval masses, of a yellowish-brown, brown, reddish-brown, or light-yellow color, with a more or less thick external stratum, of a faint-yellowish hue, and radiate appearance.

From the granulo-filamentous phytoid substance a vast profusion of *Arthromitus*, *Cladophytum*, and *Corynocladus* grow, radiating from the surface of some masses in every direction, from the summit alone of others, or hanging in festoons, the whole together presenting a most wonderful appearance, and needing no stretch of the imagination to perceive the resemblance to a most intricate forest, heightened to a very great extent by the natural anatomical arrangement of the ventriculus (Pl. IX. 1).

CHAPTER II.

A FAUNA WITHIN ANIMALS; BEING DESCRIPTIONS OF NEMATOID ENTOZOA FOUND ASSOCIATED WITH ENTOPHYTA, AND OF OTHERS ALLIED TO THEM.

Associated with the extraordinary flora of the intestinal canal of *Julus marginatus* and *Passalus cornutus*, there is also a rich fauna. Within the former animal, there exist, with a good deal of constancy, the following entozoa:—

1, *Gregarina Juli marginati*,[1] within the proventriculus; 2, *Ascaris infecta*; 3, *Streptostomum agile*; 4, *Thelastomum attenuatum*; 5, *Nyctotherus velox*;[2] 6, *Bodo julidis*;[3] and 7, a species of *Vibrio*, within the ventriculus and large intestine.

In *Passalus cornutus* are found:—

1, *Gregarina Passali cornuti*,[4] within the proventriculus; 2, *Hystrignathus rigidus*, within the ventriculus.

External to the intestinal canal, and within the abdominal cavity, there is likewise found an enormous quantity of a species of nematoid worm, apparently not fully developed,[5] and in the thoracic cavity a second species is occasionally observed.[6]

The only helminth observed in the intestinal canal of *Julus pusillus* was a species of *Gregarina*.[7]

The common cockroach, *Blatta orientalis*, contains within its intestinal canal several species of animals, frequently in great numbers, and also, according to Valentin,[8] an entophyte which grows from the mucous membrane of the large intestine. The same plant, Valentin states, grows within the rectum of *Astacus fluviatilis*. He refers it to the genus *Hygrocrocis*, under the specific name of *H. intestinalis*, and thus characterizes it: "*Fila simplicia, tenuissima, prolonga, articulata, serpentina, apice recta, moniliformia, articulis globosis.*"

A plant agreeing with this description I have not been able to find in the same insect, the cockroach, introduced into this country; but, instead of it, in the same situation mixed with the contents of the intestine, or growing from its mucous membrane, or occasionally from the nematoidea infesting the cavity, simple, inarticulate, amorphous filaments from the $\frac{1}{2500}$ to the $\frac{1}{2000}$ of an inch in diameter (Pl. VII. 7, *e*).

The entozoa of *Blatta orientalis* are: 1, *Vibrio*; 2, *Bodo*; 3, *Nyctotherus ovalis*;[9] 4, *Gregarina*;[10] 5, *Streptostomum gracile*; and 6, *Thelastomum appendiculatum*.

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[1] Trans. Am. Phil. Soc., x. 237. [2] Ib. x. 244. [3] Ib. [4] Ib. x. 238. [5] Ib. x. 241. [6] Ib. 243. [7] Ib. 238.

[8] *Repert. für Anat. und Phys.*, Band 1, S. 110, 1836. Robin: *Des Végét. qui crois. sur L'Homme*, etc., p. 82, 1847. [9] Trans. Am. Phil. Soc., x. 244. [10] Ib. x. 239.

§ 1. Description of a Species of Ascaris.

1. Ascaris infecta, Leidy.

Proc. Acad. Nat. Sci., Phila., iv., 229.

(Plate VI. Figs. 1, 2, 6, 7; VII. Figs. 5, 11, 14, 16–20, 22.)

Body nearly cylindrical, attenuated posteriorly, obtusely rounded anteriorly, white, translucent, with the brownish intestine faintly visible through the integument; tail long, conoidal, curved, acute; lobes of the mouth prominent. Buccal organ (œsophagus) robust pyriform, or oblong and dilated below; gizzard short, cordiform; intestine cylindroid, narrowing posteriorly, slightly dilated at commencement; rectum elongated, obpyriform, oblique.

Male relatively more cylindrical, with the posterior extremity incurved (Pl. VII. 5, *a*); furnished ventrally upon each side anterior to the anus, with a longitudinal row of four minute conoidal tubercles connected by delicate folds of integument; tail relatively thicker and shorter, furnished upon its ventral surface with two minute conoidal tubercles. Penis composed of two equal acinaciform spiculæ, about $\frac{1}{6}$ of a line long.

Length 2 lines; breadth at origin of intestine $\frac{1}{17\,5}$ of an inch; at middle $\frac{1}{2\,1\,0}$ of an inch; just anterior to anus $\frac{1}{2\,0\,0}$ of an inch. Length of tail from anus $\frac{1}{17\,5}$ of an inch.

Female, straight (Pl. VII. 5, *b*). Generative aperture just posterior to the middle, prominent. Vagina furnished with a large oblong ovate spermatheca.

Length of adult 3 to $4\frac{1}{2}$ lines; breadth anteriorly $\frac{1}{1\,2\,0}$ of an inch; at middle $\frac{1}{8\,5}$ to $\frac{1}{6\,0}$ of an inch; posteriorly $\frac{1}{1\,4\,0}$ of an inch.

Ova oval, $\frac{1}{3\,1\,9}$ inch long, by $\frac{1}{4\,2\,8}$ inch broad.

Especial Habitation.—Found constantly within the ventriculus of *Julus marginatus*, occasionally within the large intestine. It is sometimes very numerous, of various ages and sizes. The males are found in proportion to the females about as one to eight.

§ 2. Habits and Anatomy of Ascaris Infecta.

This *Ascaris* is frequently observed clinging by means of the mouth to the epithelial lining of the ventriculus of *Julus* (Pl. VII. 5).

In copulating, the male hangs in a sigmoid curve backwards from the female, the spiculæ of the penis introduced within the vagina of the latter (11).

Anatomy.—The buccal organ is very broad and strongly muscular. Its length is about the $\frac{1}{8\,0}$ of an inch in the female and about two-fifths less in the male (Pl. VI. 1, *a*; 2, *b*).

The gizzard is strongly muscular, and nearly as broad as it is long (1, *b*; 2, *c*).

The intestine is cylindroid, but narrows very gradually from its slightly dilated origin to its termination (1, *c*). Its central position within the cavity of the body is maintained by means of very delicate filaments which pass from the exterior surface of the organ to the interior surface of the visceral cavity (6, 7).

The mucous membrane of the intestine is lined with an epithelium composed of distinct, hexahedral, granular, nucleated, organic cells (1, 2, 6, 7).

The rectum is inverted pyriform, with an elongated narrow neck, passing in an oblique or slightly curved direction to the anal aperture. It is thinner than the intestine, and the epithelial cells of its mucous membrane are not so distinctly visible (6, *b*; 7, *b*).

To the neck of the rectum and the inner margin of the anal aperture are connected a number of muscular bands, radiating in a convergent manner from the posterior surface of the visceral cavity.

The generative apparatus (VII. 14), in the female, consists of two long ovarial tubes, one placed anterior and the other posterior to the position of the generative aperture. Each tube commences by a cœcal extremity, is irregularly cylindrical, dilatable, tortuous, and performs two small convolutions in its course, and is doubled one and a half times upon itself and the intestinal canal. Each may be considered to consist of two portions; the ovary continuous with the oviduct.

The ovary (14, *a*) dilates very gradually, from its commencement for two-thirds of its course, after which it is usually more or less irregular in its capacity, depending upon the quantity of contents; but near its termination in the oviduct, it is usually more or less abruptly narrowed and transversely contorted.

The ova within the ovary, for one-third its length, line the interior surface, in the form of nucleolated, nucleated, organic cells, polyhedral from mutual pressure. Advancing towards the oviduct, these cells gradually become larger until they arrive at the lower half of the ovary, where they are so large as to fill the caliber of the latter in a single row, and the mass of granular contents increases to such an extent that the original nucleus or the germinal vesicle of the egg is completely obscured. The ova in the lower half of the ovary are so compressible and elastic as to assume any form which may arise from exterior pressure; usually, this form is some modification of the oval.

The lower extremity of the ovary is lined with an epithelium, though indistinct and apparently not concerned in the genesis of ova.

The oviduct commences as an abrupt spheroid or pyriform dilatation (*b*), and rapidly narrows into a cylindroid tube or neck, which performs a single short convolution, and then passes into a straight very dilatable portion to join its fellow of the other extremity of the body.

The oviduct is lined from its pyriform commencement with a distinct epithelium, composed of polyhedral nucleated organic cells. Sometimes it is empty, and is then contracted to such a degree as to appear like a knotted cylindrical cord, but when distended with ova, it takes the form in outline of the mass of the latter (*c*).

The ova within the oviduct are sufficiently strong and resistant to retain their oval form.

The uterine tube (*e*), formed by the conjunction of the oviducts, is cylindroid and

strongly muscular, and when contracted, is short, thick, and transversely contorted, and curves forward to the position of the generative aperture and the spermatheca, or when elongated, is narrow, relatively twice as long as in the other case, doubled upon itself, and first proceeds backward and then forward to the spermatheca, and is smooth. Its canal is narrow, closed when at rest, and is capable of transmitting but a single egg at a time.

The spermatheca (*f*), is a large oblong or long ovoid receptacle, situated ventrally and anteriorly to the generative aperture, and is connected at its posterior extremity by the termination of the uterus and commencement of the vagina, which conjoin at an acute angle to each other.

The vagina (*g*) curves downward, and terminates in an infundibuliform generative aperture, surrounded by a thick prominent lip (*h;* Pl. VI. 1, *g*). The parietes of the vagina are thick, strongly muscular, and transversely contorted.

The ripe ova are oval (Pl. VII. 14, *c*). The young *Ascarides* (22) have the same form as the parents. In them, the generative apparatus is entirely undeveloped.

The testicles (16, *b*) of the male are long, cylindroid, lobed organs, one upon each side of the posterior part of the intestinal canal, filled with oval spermatophori (18).

The spiculæ of the penis (19), are equal, scimetar-shaped, and are protruded immediately posterior to the anal aperture (17, *c*).

§ 3. Description of the Genus and Species of Hystrignathus.

HYSTRIGNATHUS, Leidy.

Body cylindroid, rigid, finely annulated; anterior annulations, excepting the first, furnished at their posterior margin with simple spines divergent backward. Oral annulus a truncated cone; mouth round. Tail pointed. Buccal organ long cylindrical; gizzard pyriform. Generative aperture of the female near the middle of the body. Ovum oval.

Hystrignathus rigidus, Leidy.

Proc. Acad. Nat. Sci., Phila., v., 102.

(Plate VII. 8–10.)

Female.—Body straight, rigid, elastic, cylindrical, white, translucent; anteriorly and posteriorly narrowed; anterior 106 annuli, extending a short distance posterior to the position of the commencement of the ventriculus, furnished at their posterior margin with 16 simple, conoidal, divergent spines; anterior spines equal in length to the width of the annuli, the posterior decreasing to mere points; posterior annuli of the body indistinct. Oral annulus deeply truncated, conical, naked. Mouth large, round; pharynx extending through the first two annuli; buccal organ (Pl. VII. 9, *a*) cylindrical, rounded at the extremities, extending through 56 annuli; gizzard (*b*) pyriform, with a cylindrical neck, narrower than the buccal organ, and a spherical

body extending through 12 annuli; intestine cylindrical, slightly dilated anteriorly, narrowing posteriorly; rectum elongated, inverted pyriform. Tail long, narrow, conoidal, curved. Generative aperture near the middle of the body, slightly prominent.

Measurements.—Length 2 lines; greatest breadth $\frac{1}{140}$ in.; tail $\frac{1}{40}$ in. long from the anus; anterior spinous portion of the body $\frac{1}{26}$ in. long; buccal organ $\frac{1}{50}$ in. long, $\frac{1}{520}$ in. broad; gizzard $\frac{1}{190}$ in. long, with the breadth of its body $\frac{1}{320}$ in. Anterior spines $\frac{1}{2000}$ in. long. Ovum $\frac{1}{214}$ in. long, $\frac{1}{545}$ in. broad.

Habitation.—Found within the ventriculus of *Passalus cornutus*, adhering by the mouth to the mucous membrane, most usually within the sacculi, and unless it be scraped out, may escape detection. Three or four individuals are frequently found within the short blind pouch at the commencement of the ventriculus. It exists pretty constantly in numbers of two or three to twenty, rarely more.

Although I have examined over a hundred individuals of *Passalus cornutus*, I have never found a single male of *Hystrignathus*.

§ 4. Description of the Genus and Species of Streptostomum.

STREPTOSTOMUM, Leidy.

Body cylindroid, with relatively few annuli, which are very long and distinct. Mouth large, circular, without lobes or other appendages; buccal organ and gizzard pyriform. Female generative aperture posterior to the middle. Tail very long, spiculate. Penis consisting of a single spiculum.

1. Streptostomum agile, Leidy.

Proc. Acad. Nat. Sci., iv., 230; and ib. v., 285.

(Plate VI. Fig. 5; VII. 2, 12.)

Female.—Body cylindroid, narrowed at the extremities, anteriorly conoidal, divided into from 60 to 90 annulations. Oral annulus broad, with a prominent labial margin; second annulus inflated at its anterior margin. Tail very long, very straight, or slightly sigmoid, or bent at the distal extremity, linear, spiculate, ensiform, acute, shining, but slightly flexible. Mouth round, simple; buccal organ robust, pyriform, extending through thirteen annuli; gizzard robust, pyriform, with its neck subdivided into a distinct subglobular portion, extending to the twenty-first annulus; intestine cylindrical, capacious, dilated oval at its commencement; rectum inverted pyriform. Generative aperture placed twenty-four annuli anterior to the anal aperture. Ovary double; ova oval.

Measurements.—Length of body 1 line; breadth at commencement of intestine $\frac{1}{118}$ inch; at middle $\frac{1}{96}$ inch. Tail $\frac{1}{15}$ inch long by $\frac{1}{888}$ inch broad at the middle. Buccal organ $\frac{1}{190}$ inch long by $\frac{1}{320}$ inch broad; gizzard $\frac{1}{220}$ inch long by $\frac{1}{310}$ inch broad. Ova $\frac{1}{333}$ inch long by $\frac{1}{400}$ inch broad.

Habitation.—Found within the large intestine of *Julus marginatus*, and less frequently within the ventriculus.

2. Streptostomum gracile, Leidy.

Proc. Acad. Nat. Sci., v., 100; ib. v., 285.

Syn. *Oxyuris Diesingii*, Hammerschmidt: Isis, 1838, 354, Taf. iv., Fig. 6.

Oxyuris Blattæ Orientalis, Hammerschmidt: Naturwissenschaftliche Abhandlungen von Haidinger, I. 284, Taf. x., Figs. 4, 7, 13–15.

Anguillula macrura, Diesing: Systema Helminthum, II. 134.

(Plate VII. Figs. 6, 7.)

Female.—Body cylindroid, attenuated from the middle anteriorly and posteriorly. Anterior annuli very long and movable upon one another; posterior annuli shorter and not so distinct. Oral annulus short, simple; second annulus long, constricted in the middle. Tail nearly one-third the length of the body, straight or curved, spiculate, shining. Mouth round, simple; buccal organ elongated pyriform, with the neck cylindroid, dilated at its commencement and middle, extending through ten annuli; gizzard with a narrow cylindroid neck and globular body, extending to the eighteenth annulus; intestine cylindroid, very largely dilated oval at commencement.

Measurements.—Length of body 1 line; breadth opposite the ventricular dilatation $\frac{1}{135}$ inch; greatest do. $\frac{1}{107}$ inch; just above anus $\frac{1}{300}$ inch. Tail $\frac{1}{40}$ inch long by the $\frac{1}{1300}$ inch broad at middle. Buccal organ $\frac{1}{150}$ inch long; gizzard $\frac{1}{213}$ inch long. Ovum oval, $\frac{1}{300}$ inch long, $\frac{1}{625}$ inch broad.

Habitation.—Found within the intestinal canal of *Blatta orientalis*.

§ 5. Description of the Genus and Species of Thelastomum.

THELASTOMUM, Leidy.

Body cylindroid, annuli moderately long. Oral annulus papillæform. Mouth small, circular, without lobes or other appendages; buccal organ long, cylindrical; gizzard pyriform. Tail moderately long, spiculate. Penis consisting of a single spiculum.

1. Thelastomum attenuatum, Leidy.

Proc. Acad. Nat. Sci., iv., 231; ib. v., 285.

(Plate VI. Fig. 4; VII. 1, 23.

Female.—Body cylindroid, translucent white, shining, attenuated anteriorly from the commencement of the intestine, divided into from 140 to 160 annulations. Oral annulus minute, papillæform; second annulus small, compressed oval. Tail very straight, or slightly curved, slender, spiculate, acute. Mouth small, simple; its passage extending through two and a half annuli; buccal organ and gizzard extending through 55 annulations, the former, very long, cylindrical, rounded at

the extremities; the latter pyriform, with a short neck, and narrower than the buccal organ; intestine cylindrical, dilated, subcordiform at commencement; rectum inverted pyriform. Generative aperture 42 annulations anterior to the anal.

Measurements.—Length of body $\frac{1}{10}$ to $\frac{1}{8}$ of an inch; breadth at middle $\frac{1}{95}$ of an inch. Tail $\frac{1}{14}$ of an inch in length by $\frac{1}{1000}$ of an inch broad at middle. Buccal organ $\frac{1}{4}$ line long by $\frac{1}{535}$ of an inch broad; gizzard $\frac{1}{178}$ of an inch long.

Ova $\frac{1}{333}$ of an inch long by $\frac{1}{400}$ of an inch broad.

Habitation.—Found with *Streptostomum agile*, within the large intestine of *Julus marginatus*.

2. Thelastomum appendiculatum, Leidy.

Proc. Acad. Nat. Sci., v., 101; ib. 285.

Syn. *Oxyuris Blattæ orientalis*, Hammerschmidt: Naturwiss. Abhandl. von Haidinger, I. 284, Taf. x. Figs. 10–12 (*male*, 8, 9, 20?).

(Plate VII. Fig. 3.)

Female.—Body cylindroid, translucent white, attenuated anteriorly and posteriorly; divided into from 80 to 90 annulations. Oral and second annulus, as in the preceding species; terminal annulus with two short spines projecting backward. Tail straight, spiculate, one-fourth the length of the body. Mouth small, simple; its passage extending to the third annulus; buccal organ and gizzard extending to the thirtieth annulation; the former long, cylindrical; the latter pyriform; commencement of the intestine broad, cordiform, becoming cylindroid and sending off a large diverticulum. Generative aperture 26 annulations anterior to the anal.

Measurements.—Length of body 1 line to $\frac{1}{10}$ of an inch; breadth at commencement of the ventriculus $\frac{1}{100}$ of an inch; at middle $\frac{1}{80}$ of an inch; at anus $\frac{1}{160}$ of an inch. Tail $\frac{1}{4}$ of a line long by $\frac{1}{888}$ of an inch broad at middle. Buccal organ $\frac{1}{80}$ of an inch long; gizzard $\frac{1}{240}$ of an inch long. Ovum semi-oval, $\frac{1}{260}$ of an inch in length by $\frac{1}{666}$ of an inch broad.

Habitation.—Found with *Streptostomum gracile* in the intestinal canal of *Blatta orientalis*.

3. Thelastomum labiatum, Leidy.

Proc. Acad. Nat. Sci., v. 101; ib. 285.

(Plate VII. Fig. 13.)

Female.—Body cylindroid, transparent, anteriorly and posteriorly attenuated, divided into 140 annulations, of which the anterior are very strongly marked. Oral annulus inflated, six-lobed at the margin; second annulus constricted anteriorly. Tail straight, spiculate, very nearly half the length of the body. Mouth round, extending through one and a half annuli; buccal organ and gizzard extending to the fortieth annulus; the former cylindroid; the latter robust; intestine at commencement subcordiform.

Measurements.—Length $\frac{1}{2}$ of a line to $\frac{1}{20}$ of an inch; breadth $\frac{1}{200}$ of an inch. Length of tail $\frac{1}{40}$ of an inch. Buccal organ $\frac{1}{120}$ of an inch; gizzard $\frac{1}{320}$ of an inch. Ovum oval, $\frac{1}{333}$ of an inch long by $\frac{1}{600}$ of an inch broad.

Habitation.—Found within the ventriculus and large intestine of *Polydesmus virginiensis.*

4. Thelastomum robustum, Leidy.

Proc. Acad. Nat. Sci., v., 101; ib. 285.

Female.—Body white, cylindrical, narrowed anteriorly and posteriorly, divided into from 200 to 220 annulations. Oral annulus simple. Tail straight, little more than one-eighth the length of the body. Mouth round, simple; buccal organ and gizzard extending through forty annulations; intestine largely dilated oval at commencement. Generative aperture 70 annulations anterior to the anal.

Measurements.—Length of body 2 lines; breadth at the commencement of the intestine $\frac{1}{75}$ of an inch; at middle $\frac{1}{66}$ of an inch; just above the anus $\frac{1}{75}$ of an inch. Length of tail $\frac{1}{22}$ of an inch; breadth at middle $\frac{1}{1000}$ of an inch. Buccal organ $\frac{1}{50}$ of an inch long; gizzard $\frac{1}{175}$ of an inch. Ovum $\frac{1}{300}$ of an inch long by $\frac{1}{500}$ of an inch broad.

Habitation.—Intestinal canal of the larva of a lamellicorn coleopterous insect.

5. Thelastomum brevicaudatum, Leidy.

Proc. Acad. Nat. Sci., v., 208; ib. 285.

Female.—Body cylindroid, anteriorly rapidly narrowing from the commencement of the intestine, posteriorly abruptly rounded; with a very short spiculate tail.

Measurements.—Length of body to 2 lines; breadth at commencement of intestine $\frac{1}{75}$ of an inch; at middle $\frac{1}{80}$ of an inch; just above anus $\frac{1}{133}$ of an inch. Length of tail from anus $\frac{1}{200}$ of an inch. Buccal organ $\frac{1}{66}$ of an inch long; gizzard $\frac{1}{250}$ of an inch long. Ovum oval, $\frac{1}{285}$ of an inch long.

Habitation.—Intestine of the larva of *Scarabæus relictus.*

6. Thelastomum gracile, Leidy.

Proc. Acad. Nat. Sci., v., 285.

Oxyuris gracilis, Hammerschmidt: Isis, 1838, 353, Tab. IV. c–f; Naturwis. Abhandl. v. Haid. I. 287, Tab. X. Figs. 21–25.
Anguillula gracilis, Diesing: Syst. Helm. II. 133.

7. Thelastomum depressum, Leidy.

Oxyuris depressa, Hammerschmidt: Isis, 1838, 354, Tab. IV. d. e.
Oxyuris dilatata, Hammerschmidt: Naturwis. Abhandl. v. Haid. I. 287, Tab. X. Figs. 26, 27.
Thelastoma dilatatum, Leidy: Proc. Acad. Nat. Sci., v., 285.
Anguillula depressa, Diesing: Syst. Helm. II. 133.

8. Thelastomum laticolle, Leidy.

Proc. Acad. Nat. Sci., v., 285.

Oxyuris laticollis, Hammerschmidt: Naturwis. Abhandl. v. Haid. I. 288, Tab. X. Figs. 28–34.
Anguillula laticollis, Diesing: Syst. Helm. II. 134.

§ 6. History, Structure, etc., of Streptostomum, and Thelastomum.

In *Thelastomum*, the body is longer, has shorter and more numerous annulations, and a shorter tail than in *Streptostomum*. In the former, also, the buccal organ is relatively very long, and cylindrical, in the latter short and pyriform. In *Oxyuris* the body is relatively longer than in either the above, is more shortly and numerously annulated, and has the tail constructed like that of *Ascaris*, instead of being straight and spiculate, as in the former genera.

In *Ascaris* and *Oxyuris* the tail appears to be formed by the gradual attenuation of the body posteriorly to a point; in *Streptostomum* and *Thelastomum* it has more the appearance of being a superadded appendage, even in the species *Thelastomum brevicaudatum*, which has comparatively a very short tail.

In the two genera last mentioned, the tegumentary envelop of the body is so transparent that all the interior structures are distinctly visible. The integument is lined by two layers of muscular fibres, the first transverse, the second and stronger, longitudinal.

Within the muscular investment, apparently upon one side only, in *Streptostomum* just posterior to the commencement of the intestine (Pl. VII. 2, *e*), and in *Thelastomum* at the termination of the buccal organ (1, *e*), is an apparent follicle, communicating with the exterior, and having its bottom connected by means of radiating bands of fibres to the external surface of the alimentary canal in its vicinity.

Along the course of the interior ventral surface are situated several other apparently glandular organs (Pl. VI. 4, *e*).

The intimate structure of the alimentary canal presents nothing different from that given in the account of *Ascaris infecta*.

A remarkable special peculiarity in the construction of the intestine is observable in *Thelastomum appendiculatum*. In all other species of the genus, and in *Streptostomum*, the intestine is simply cylindroid, straight throughout, and more or less dilated into different forms at its commencement. In *Thelastomum appendiculatum* (Pl. VII. 3), the intestine commences by a broad, deeply sinuate cordiform dilatation, which rapidly narrows to a short cylindroid portion and then sends off a long, capacious, gourd-form receptacle, or diverticulum (*d*), and afterwards proceeds backwards to the rectum, and in its course, in the vicinity of the generative aperture, performs a single short convolution.

The generative apparatus (Pl. VI. 4) of *Streptostomum* and *Thelastomum* is constructed upon the same plan as that of *Ascaris infecta*, except that there is no spermatheca, and the dilatable portions of the oviducts terminate at once in the vagina, which passes obliquely backward, and ventrally to the generative aperture.(*d*)

CHAPTER III.

UPON PSEUDO-ENTOPHYTA, ETC.

True free or unattached entophyta are comparatively rare, within the alimentary canal of animals, because they possess no means of counteracting expulsion with the ordinary contents of the bowels. They may, however, not unfrequently exist where they have a very rapid reproductive power, and are so small that many escape removal at any single expulsive effort of the organ which contains them.

The *Sarcina ventriculi*, Goodsir, is an entophyte of the latter character, which being very minute, and rapidly reproduced, is not easily expelled from the stomach under the circumstances in which it is found.

Vibriones, and closely allied but not spontaneously moving filaments, very frequently met with in the intestinal contents of herbivorous animals, are probably true floating or free entophyta, which by their very great minuteness and energetic reproductive power are prevented from entire removal from the alimentary canal.

In the study of the vegetable parasites of animals, particularly those of the intestinal canal, it is necessary to be careful not to confound the tissues of certain well-known cryptogamic plants, which may serve as food or adhere to the ordinary food of such animals, with true entophyta. Thus fragments of fungi, confervæ, lichenes, and the spores of these, used as food, or adhering as foreign matter to food of an ordinary kind, are liable within the intestine to be mistaken for parasites.

In midwinter, I found beneath an old fence-rail, an individual of *Acheta nigra*, or large black cricket, within the proventriculus of which were large quantities of what I supposed at the time to be a free, floating entophyte, resembling in general appearance the ordinary yeast fungus, *Torula*, but which I now suspect to be an ergot upon which the animal had fed (Pl. X. 8). The plant consisted of oblong or oval vesicular bodies, apparently thickened at the poles, and filled with a colorless liquid; but this appearance more probably arose from the cells being distended with a single large, transparent, colorless, amorphous globule, which pressed a small existing amount of protoplasma to each end of the cavity. The cells were single, or in rows to eighteen in number. Frequently, a single cell of comparatively large size had an attached pair of cells or rows of cells at one or both ends. Occasionally they were met with, containing one or two small round hyaline, amorphous nuclei.

The isolated cellules measured from the $\frac{1}{7500}$ to the $\frac{1}{16666}$ of an inch in length

by the $\frac{1}{8000}$ to the $\frac{1}{6000}$ of an inch in breadth. The rows measured up to the $\frac{1}{800}$ of an inch in length.

Of a doubtful character, as an entophyte, are also some vegetable bodies which I observed floating in a honey-colored liquid of the proventriculus of a larva of *Arctia Isabella*, a lepidopterous insect, which I found hybernating beneath a stone in the early part of the month of January.

These bodies in outline resemble the caudex, with its connected radicles, of certain phanerogamous plants (Pl. X. 26).

The caudex-like portion was irregularly oblong or fusiform, brown in color, opaque, and measured from the $\frac{1}{2500}$ to the $\frac{1}{625}$ of an inch long, and the $\frac{1}{10000}$ to the $\frac{1}{4000}$ of an inch broad.

The filaments were hyaline, cylindrical, irregular in their course, and branching. They rarely presented the appearance of a partition, and possessed amorphous or very faintly granular contents, with an occasional coarse, isolated granule. Their diameter was pretty uniformly about the $\frac{1}{11000}$ of an inch. Mixed with them, generally separated, frequently attached, were numerous sporuloid bodies, oblong in form, two or three times as long as they were broad, and having the same structure as the filaments.

The spores of many cryptogamic plants form a very frequent constituent of the ordinary contents of the bowels of many animals.

It is not improbable that an occasional new species of cryptogamic plant which grows externally, but has escaped observation, might be discovered in the examination of the contents of the intestine of such animals as the earth worms, herbivorous myriapoda, herbivorous insects, batrachians, and chelonians.

Among a variety of cryptogamic forms, which I have observed mixed with the contents of the bowels of a number of animals, are several, which, from the singularity of their appearance and the probable importance of directing attention to a source which may lead to the discovery of new external plants, I will briefly notice.

One of these is a long cylindrical articulated body, occasionally found mixed with the food of *Julus*, *Polydesmus*, *Passalus*, and *Lumbricus*. It is purplish-brownish in color, with from 9 to 14 articulations, slightly constricted at the conjunction of the latter. The extremities are obtusely angular, or one is prolonged into a sort of pedicle or foot-stalk, expanded at what is the free end in the specimens. The contents of the articulations consist of a central cylindroid, amorphous, transparent mass, or one or a few aggregated globules, inclosed in a darker amorphous matter which appears to be a continuous structure of the cell-wall (Pl. X. 4, 5).

The length of these bodies is about the $\frac{1}{225}$ of an inch by the $\frac{1}{2500}$ of an inch in breadth. The articulations are equal to the diameter, but are sometimes larger, up to the $\frac{1}{2142}$ of an inch in length.

A second remarkable vegetable organism was observed several times among the contents of the ventriculus of *Passalus cornutus* and *Julus marginatus*. This was a *Gonium*-like body, of a dark olive-brownish color, composed of from nineteen to twenty-seven articulations arranged in four rows side by side, the two outer uniting at one end in the form of U, and inclosing the other two, which, in some cases,

ceased on a level with the extremities of the arms of the U, at others projected two articulations beyond. The articulations were amorphous in structure, with from one to four minute, indistinct, nucleolar bodies (Pl. X. 6, 7).

They measured from the $\frac{1}{1000}$ to the $\frac{1}{750}$ of an inch in length by the $\frac{1}{1428}$ to the $\frac{1}{1200}$ of an inch in breadth, and had a thickness corresponding to the diameter of the articulations, which, on an average, was about the $\frac{1}{6000}$ of an inch.

In water, these bodies had a slight lateral oscillating movement.

Another curious body, probably a polyspore, I observed several times mixed with the food within the ventriculus of *Passalus cornutus* (Pl. X. 13). This was V-formed, articulated, translucent, and purplish-brown in color, and measured along each arm upon the outer side about the $\frac{1}{875}$ of an inch. It consisted of eight articulations, which were amorphous in structure. The articulation forming the apex was a small inverted cone, upon the base of which was placed the second articulation which terminated above in two oblique lateral faces, from each of which projected in a line three articulations forming the divergent arms of the body. The last articulation of the latter was long and spine-like.

Some cryptogamic spores, which may be taken into the alimentary canal with the food of the animal, may there commence their development into a mycelium, though belonging to plants which grow externally.

Of this character are certain sporular bodies which I have observed frequently existing among the contents of the cloaca of batrachian animals, the plant of which only completes its development exposed to the air upon the surface of the expelled excrement (14–25).

Generally, the sporular bodies, found under the circumstances just mentioned, are globular, and more or less extended upon one side into a cylindroid or clavate prolongation (14–21). Each extremity is almost always occupied by a single, large spherical, oval, or pyriform, hyaline, amorphous body, in the interspace of which the cell-like sporules are filled with a finely granular protoplasm.

Rarely do these bodies advance in their development within the animal more than has been just described, but occasionally a branching mycelium is met with, of small extent, consisting of oblong cellules attached by their rounded extremities (22). The contents of the cellules consist of a colorless liquid protoplasm, sometimes entirely, but generally occupying one extremity of the cells, while the other is filled by a mass of fine granular matter, with a small round hyaline, nuclear body.

Exterior to the animals, in the excrement, the vegetable bodies under consideration form an extensively ramifying, articulated mycelium, which sends up straight filaments into the air, producing at the free extremity one or more rows of oval, granular, sporular bodies (23). Filaments, also, of the mycelium are not unfrequently found, in which comparatively large globular spores have been developed, apparently by an accumulation of the entire granular matter, as it ordinarily exists, of a single articulation (24).

All the cryptogamic plants described in the preceding pages are innocent denizens of, or travellers through, the intestinal canal of animals. But, besides plants of this character, there are many parasitic fungi of animals which are entirely destructive to life. Such are the Muscardine, *Botrytis bassiana*, Balsamo, so injurious to the

silk-worm,[1] and several species of *Sphæria* and *Isaria*, which also grow within and upon insects and their larvæ.

These fungi grow with great rapidity within the body of the animal they attack, not only at the expense of the nutritive fluids of the latter, but, after its death, all the interior soft tissues appear to be converted into a solid mass of mycelium, from which arise one or more aerial receptacles of the spores.

I once found a specimen of *Gryllo-talpa americana*, sitting at the mouth of a hole beneath a log, apparently in perfect health, but, upon nearer examination, found it had been so completely invaded by a fungous mycelium that even the joints of the tarsi were distended with it.

The same kind of fungous substance I have observed distending the bodies of larvæ of several species of our indigenous lepidoptera, and once, also, the larva of a lamellicorn insect.

Of a closely analogous character is a fungus which I found to be very common in the seventeen-year locust, *Cicada septendecim*, under the following circumstances:—

In a number of the female insects, within the vagina and projecting externally, I frequently observed a moist, white, filamentous substance, which I supposed to be spermatic matter, but, upon examination, found to be composed of a mycelium of fungous filaments (Pl. X. Figs. 27, 28). Most of these were branching, inarticulate, from the $\frac{1}{9000}$ to the $\frac{1}{8600}$ of an inch in diameter, and were filled with a hyaline protoplasma, with an occasional isolated yellowish granule. Others were united to several oblong cells, or were continuous with what appeared to be the original spore, and contained a protoplasma, and hyaline amorphous globules. With the filaments were intermingled numerous round or oval spore-like bodies, from the $\frac{1}{1400}$ to the $\frac{1}{1000}$ of an inch in diameter, colorless, and with hyaline granular contents and one or several nuclei (29).

In the spring of 1851, during the imago appearance of the seventeen-year locust, among myriads of the insect, several friends and myself found between 12 and 20 specimens, which, though living, had the posterior third of the abdominal contents converted into a dry, powdery, ochreous-yellow, compact mass of sporuloid bodies. The caudal appendages and posterior two or three abdominal rings covering the mass, were loose and easily detached, leaving the fungoid matter in the form of a cone, affixed by its base to the unaffected part of the abdomen of the insect.

The sporuloid bodies, which constituted the entire mass, were oval or ovate in form, with a wrinkled surface, and faintly granular contents, and measured from the $\frac{1}{2800}$ to the $\frac{1}{1400}$ of an inch long, by the $\frac{1}{3500}$ to the $\frac{1}{2333}$ of an inch broad.

From the observations thus made upon the fungous disease of the seventeen-year locust, it is probable the insect is more liable to it than we can have any means of estimating. The fungus may commence its attack upon the larva of the insect, develop its mycelium, and produce a sporular mass within the active chrysalis, while ascending and descending its chimney to receive full benefit from the air, and in

[1] Eighteen years ago, a younger brother and myself, for our amusement, reared several thousand silk-worms, among which we often observed and carefully removed what we then called "mouldy silk-worms," or "silk-worms affected with the mould disease."

this stage destroy many which we, of course, never after see, because we never seek for them. If the fungus has invaded the insect only to such an extent as not to destroy organs immediately essential to its life, it may pass through its metamorphosis into the imago, but with the posterior part of the abdomen filled with a mass of fungous substance, as described above.

The reason of the fungous production being always found in the last-mentioned situation, arises, probably, from the fact that the access of the sporules to the interior of the animal is much easier through the generative and anal apertures than through the more delicate passage of the proboscis.

It is probable that this fungous disease of the seventeen-year locust is one of the means of maintaining the equilibrium in the aggregate of the life of the species under existing circumstances.[1]

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[1] I say under existing circumstances, for if these change, the species may be either increased or diminished, or even extinguished; but has not life in the aggregate ever been fixed in its extent? If so, then if a species be increased, diminished, or extinguished, the equilibrium of life in the aggregate has still been preserved by another or several other species having diminished, increased, or primitively originated.

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REFERENCES TO THE PLATES AND FIGURES.

PLATE I.

Fig. 1. Numerous thalli of *Enterobryus elegans*, growing from a portion of mucous membrane of the ventriculus of *Julus marginatus*. The breadth of the thalli, in the drawing, is greater than the relation of their length.

a. Mucous membrane, covered with hexahedral epithelial cells.
b. Primary cells of *Enterobryus*, filled with granules and globules.
c. Spiral turn performed by the thallus of *Enterobryus elegans* in its course of growth.
d. Extremity of a primary cell filled with granular matter.
e. Secondary cells, usually filled with granular matter.
f. One of the secondary cells burst, with an escape of the mixed liquid and granular contents.
g. *Arthromitus*, a frequent parasitic algoid plant upon *Enterobryus*.
h. Pedicle of attachment of *Enterobryus*.
i. A thallus in outline, terminated by a single secondary cell.

Fig. 2. Thalli of *Enterobryus attenuatus*, growing from a shred of basement-membrane, from the ventriculus of *Passalus cornutus*, magnified about twenty diameters.

Fig. 3. Five thalli of *Enterobryus attenuatus*, very highly magnified.

a. Basement-membrane of the mucous membrane of the ventriculus of *Passalus cornutus*.
b. Primary cells, filled with the characteristic contents of liquid, granules, and globules.
c. Pedicle.
d. A few filaments of *Arthromitus*, parasitic upon the *Enterobryus*.

Fig. 4. Four thalli of *Enterobryus spiralis*, growing from a portion of mucous membrane, from the ventriculus of *Julus pusillus*.

a. Hexahedral epithelia of the mucous membrane.
b. Thalli of *Enterobryus*, exhibiting the spiral arrangement and internal structure.
c. Primary cell.
d. Secondary cells.
e. Pedicle of attachment.

PLATE II.

Fig. 1. Numerous thalli of *Enterobryus elegans*, growing from a portion of mucous membrane of the ventriculus of *Julus marginatus*.

a. Outline of the portion of mucous membrane.
b. Cylindrical epithelial cells of the mucous membrane.
c. Young thalli of *Enterobryus*, filled with the characteristic contents of liquid, globules, and a relatively small quantity of granules.
d. Pedicle of attachment.
e. Masses of parasitic, granulo-filamentous, phytoid matter, growing upon the mucous membrane.
f. The same kind of matter, growing upon the *Enterobryus*.

g. *Cladophytum*, parasitic upon the granulo-filamentous matter.

h. *Cladophytum*, parasitic upon the *Enterobryus*.

i. Bunches of *Arthromitus cristatus*, growing in similar positions as the *Cladophytum*.

Fig. 2. Portion of the mucous membrane of the lower extremity of the large intestine of *Julus marginatus*, with very numerous young thalli of *Enterobryus elegans*.

a. Mucous membrane in outline.

b. Epithelia.

c. Young thalli of *Enterobryus*, in outline.

d. Two thalli, with granular contents and a very few globules.

Fig. 3. A single young thallus of *Enterobryus elegans*, from the same position as Fig. 2, but more magnified, so as to exhibit the contents.

a. The primary cell, with granular contents and a few globules.

b. The pedicle.

Fig. 4. A single individual of *Enterobryus elegans*, from the ventriculus of *Julus marginatus*, artificially twisted, exhibiting well the appearance of the interior contents.

a. The primary cell.

b. Its watch-crystal like termination.

c. The pedicle of attachment.

PLATE III.

Exhibits the structure of *Enterobryus*.

Fig. 1. Distal portion of a primary cell, with an unusually short attached secondary cell of *E. elegans*.

a. The portion of the primary cell filled with granules and globules.

b. A secondary cell, filled with granules. The distal extremity of this cell is abruptly terminated, and the cell-membrane rises like the crystal of a watch from its dial.

Fig. 2. Central portion of a primary cell distended with globules. A few very minute granules are visible.

Fig. 3. Proximal or attached portion of a primary cell.

a. Portion of the primary cell; its lower end slightly dilated, filled with globules and granules.

b. Portion of the pedicle.

Fig. 4. Dilated distal extremity of a primary cell, filled with globules; the latter, in the upper portion, polyhedral from pressure.

Fig. 5. Central portion of the same cell containing granules and globules.

Fig. 6. Proximal portion of the same thallus.

a. Portion of the principal cell filled with granules and globules.

b. The pedicle.

c. Its expanded basis of attachment.

Fig. 7. Distal portion of a primary cell, filled with granules and globules, its upper end terminating abruptly, with the cell-membrane rising like the crystal of a watch.

Fig. 8. Central portion of the same thallus, filled with granules and very large globules.

Fig. 9. Proximal portion of the same thallus.

a. Portion of the primary cell, filled with granules mixed with a few globules.

b. The pedicle of attachment, with four transverse contortions.

c. Its expanded base of attachment.

Fig. 10. Middle portion of a primary cell, very highly magnified, containing globules and granules.

Fig. 11. Proximal portion of the same individual as the last.

a. Portion of the primary cell, with globules and granules.

b. The pedicle, cut off below.

Fig. 12. Distal portion of a primary cell, clavate in form, filled with granules and globules, and having its summit crowned with a profuse bunch of *Arthromitus*.

Fig. 13. Distal extremity of a primary cell of *Enterobryus elegans*, distended with a single row of large globules.

Fig. 14. Do. clavate in form, distended with large polyhedral globules.

Fig. 15. Distal extremity of a thallus of *Enterobryus attenuatus*, with a short secondary cell.

a. Portion of the primary cell, filled with protoplasma, granules, and a few globules.

b. Secondary cell, burst at its upper extremity, and allowing globules of the protoplasma and granules to escape.

Fig. 16. Distal extremity of an individual with a longer secondary cell.

a. Portion of the primary cell, with granules and a few globules.

b. Secondary cell filled with protoplasma, containing a few scattering granules.

Figs. 15 and 16 are representations of the only two instances of secondary cells which I ever observed in *Enterobryus attenuatus*.

Fig. 17 represents the distal portion of a number of individuals of *Enterobryus attenuatus*, exhibiting the variations of the interior structure.

a. Distended with globules, varying in size in different individuals, but very uniform in the same individual.

b. Filled with granules and globules irregular in size.

c. Outline of a portion of the primary cell.

d. Thickening of the cell-wall around the margin of the free extremity.

PLATE IV.

Fig. 1. A dead thallus of *Enterobryus elegans*.

a. The pedicle.

b. The primary cell.

c. The contracted or shrunken primordial utricle.

d. Oil-like globules.

e. Branches of *Cladophytum*.

Fig. 2. Distal extremity of a thallus, with the contents shrunken from the application of acetic acid.

Fig. 3. Spores? of *Enterobryus elegans*.

Figs. 4–17. Young thalli of *Enterobryus elegans*.

Fig. 4. Very young condition: Length $\frac{1}{1\,3\,0\,0}$ inch.

a. Point of attachment.

Figs. 5, 6. Further advanced: Length $\frac{1}{8\,8\,0}$ inch.

a. Young primary cell.

b. Pedicle.

Fig. 7. Young thallus constricted at the middle: Length $\frac{1}{5\,3\,5}$ inch; breadth $\frac{1}{2\,0\,0\,0}$ inch.

Fig. 8. Young thallus: Length $\frac{1}{3\,8\,0}$ inch; breadth $\frac{1}{1\,0\,0\,0}$ inch.

a. Pedicle.

Fig. 9. Do. constricted at the lower portion of the primary cell, which is filled with protoplasma, granules, and a few globules: Length $\frac{1}{2\,3\,0}$ inch.

Fig. 10. Do. curved, clavate, distended with globules: Length $\frac{1}{1\,0\,0}$ inch.

Fig. 11. Do. same form as last: Length $\frac{1}{6\,0}$ inch.

Fig. 12. Do. $\frac{1}{7\,5}$ inch long.

Fig. 13. Do. straight, clavate, distended with globules: Length $\frac{1}{1\,1\,3}$ inch.

Fig. 14. Do. long, straight, and clavate: Length $\frac{1}{6\,0}$ inch.

Fig. 15. Do. constricted at its upper third: Length $\frac{1}{6\,0}$ inch.

a. Pedicle.

b. Epithelial cells of the mucous membrane.

Fig. 16. Three young thalli growing from a portion of mucous membrane, from a young *Julus marginatus*, one inch long.

a. Primary cell, filled with globules: Length $\frac{1}{2\,0\,0}$ inch.

b. Do. clavate in form: Length $\frac{1}{3\,0\,0}$ inch.

c. Do. overgrown with *Arthromitus*: Length $\frac{1}{7\,5\,0}$ inch.

d. *Cladophytum*.

c. Basement-membrane.

f. Epithelial cells.

Fig. 17. Do. geniculate, $\frac{1}{100}$ inch long.

Fig. 18. Distal portion of an ultimate secondary cell of *Enterobryus elegans*, filled with granules and a few globules, and having a tuft of *Cladophytum* growing from the summit.

Fig. 19. Proximal portion of the ultimate cell (*a*), and distal portion of the penultimate cell (*b*), of the same individual as Fig. 18, filled with granules.

Fig. 20. Proximal portion of the penultimate cell (*a*), filled with granules, and distal portion of the primary cell (*b*), filled with granules and globules.

Fig. 21. Distal portion of an ultimate cell, filled with granules.

Fig. 22. Proximal portion of an ultimate cell, filled with granules (*a*), and distal portion of the penultimate cell, filled with globules and granules (*b*).

c. Point of division of the two secondary cells.

Fig. 23. Proximal portion of the penultimate cell (*a*), and distal portion of the primary cell (*b*), filled with granules and globules.

c. Line of separation of the primary from the secondary cells.

Fig. 24. Distal extremity of a secondary cell, filled with granules.

Fig. 25. Proximal extremity of the same cell, filled with granules (*a*), and distal portion of the primary cell, filled with granules and a few globules (*b*).

c. Line of separation between the primary and secondary cell.

Fig. 26. A young thallus of *Enterobryus attenuatus*, having an abnormal bud-like prominence at the attached extremity of the primary cell. Large globules distend its upper half; small ones its sigmoid flexure, and protoplasma fills the attached end and the bud. Length $\frac{1}{42}$ of an inch.

a. Primary cell.

b. Bud.

c. Pedicle.

Fig. 27. A bunch of *Enterobryus attenuatus*, in which the primary cells are of very nearly uniform diameter throughout, growing from a portion of basement-membrane. Length 1 line.

a. Principal cells, filled with globules, granules, and protoplasma; the lower portions, excepting one, in outline.

b. An individual, in which two principal cells grew from one pedicle. The only instance of the kind I ever met with.

c. Pedicle.

d. *Cladophytum*.

e. Basement-membrane.

Fig. 28. Large bunch of *Enterobryus elegans*, growing from a portion of mucous membrane.

a. Primary cells.

b. Penultimate secondary cell.

c. Ultimate secondary cell.

d. Pedicle of attachment.

e. Thallus in outline.

f. Bunches of *Cladophytum comatum*.

g. Basement-membrane.

h. Epithelial surface.

PLATE V.

Figs. 1, 2. Secondary cells of *Eccrina longa*. All were filled with granular matter.

Fig. 1. *a*. A distal extremity of the primary cell, filled with granules and globules.

b. Outlines of secondary cells.

c. Secondary cell, filled with granules.

Fig. 2. *a*. Outlines of secondary cells.

b. Secondary cells, filled with granules.

c. Thickening of the cell-wall at the place of division of the secondary cells.

Fig. 3. *a*. Distal portion of the primary cell of *Eccrina longa*, filled with granules and globules.
b. First secondary cell, filled with granules.
c. Outline of second secondary cell.
d. *Arthromitus* growing from *Eccrina*.
e. Its nucleus of attachment.
f. A tuft of *Cladophytum*.
g. Its nucleus of attachment.

Fig. 4. Terminal secondary cells of the same thallus as Fig. 3.
a. Filled with granules.
b. In outline.

Fig. 5. Secondary cells of *Eccrina longa*.
a. In outline.
b. Filled with granules.
c. Detached cells, which appear to adhere by one end to the sides of the parent thallus.

Fig. 6. Three detached secondary cells.
a. Filled with globules and granules.
b. In outline.

Fig. 7. Young thallus of *Eccrina longa* distended with globules; its upper part considerably dilated.

Figs. 8–13. Different forms assumed by the young of *Eccrina longa*.

Fig. 8. $\frac{1}{214}$ inch long; 9, $\frac{1}{430}$ inch; 10, $\frac{1}{214}$ inch; 11, $\frac{1}{250}$ inch; 12, $\frac{1}{214}$ inch; 13, more highly magnified, $\frac{1}{100}$ inch.

Fig. 14. *Arthromitus cristatus*, from the large intestine of *Julus marginatus*.
a. Nucleus of origin.
b. Mucous membrane.
c. Consolidated articuli.
d. Spores.
e. *Cladophytum*.

Fig. 15. Portion of another individual, more highly magnified.
a. Developing sporules.
b. Ripe sporules.

PLATE VI.

Fig. 1. An individual of *Ascaris infecta*, which had a large number of thalli of *Enterobryus elegans* growing upon it.
a. Buccal organ.
b. Gizzard.
c. Intestine.
d. Rectum.
e. Anus.
f. Ovary.
g. Generative aperture.
h. Bunches of *Arthromitus* growing upon the thalli of *Enterobryus*.

Fig. 2. Anterior portion of the body of *Ascaris infecta*, with three thalli of *E. elegans* growing upon it.
a. Lobes of the mouth.
b. Buccal organ.
c. Gizzard.
d. Commencement of intestine.
e. Ganglia.
f. Primary cells of *Enterobryus*, filled with granules and globules, and having very numerous bunches of *Arthromitus* growing upon them.
g. Pedicle of attachment.

Fig. 3. Portion of a thallus, with numerous bunches of *Arthromitus cristatus* growing upon it.

Fig. 4. Middle portion of the body of *Thelastomum attenuatum*, with two thalli of *Enterobryus* growing from it.

a. Intestine; the spots represent its epithelial cells.
b. Oviduct.
c. Vagina.
d. Generative aperture.
e. Tegumentary glands.
f. *Enterobryus*.
g. Pedicle.
h. *Arthromitus*.
i. Bunch of *Arthromitus* growing from the generative aperture.

Fig. 5. Posterior portion of the body of *Streptostomum agile*.

a. Annuli of the body.
b. Tail, cut off below.
c. Posterior extremity of the intestine, with the hexahedral epithelial cells visible.
d. Rectum.
e. Anus.
f. Bundles of muscular fibres.
g. Portion of the oviduct containing an ovum.
h. *Enterobryus elegans*.
i. Bunches of *Arthromitus cristatus*.

Fig. 6. Side view of the posterior extremity of *Ascaris infecta*.

a. Portion of the intestine.
b. Rectum.
c. Anus.
d. Portion of *Enterobryus elegans*, with a very long pedicle of attachment (*e*).

Fig. 7. Posterior view of the posterior extremity of *Ascaris infecta*.

a. Intestine.
b. Rectum.
c. Young thallus of *Enterobryus*, with a very long pedicle (*d*), growing from the tail.
e. *Arthromitus cristatus*.
f. *Cladophytum comatum*.

Fig. 8. Alimentary canal of *Passalus cornutus*.

a. Proventriculus.
b. Ventriculus.
c. Intestine.

Fig. 9. Ventriculus of *Passalus*.

a. Commencement.
b. Cæcal pouch opening into the ventriculus.

Fig. 10. Inferior portion of the ventriculus laid open.

a. The mouths of the saeculi.
b. The longitudinal folds.
c. The transverse folds.
d. V-shaped corneous plates.
e. Commencement of the fecal intestine.

PLATE VII.

Fig. 1. Anterior extremity of *Thelastomum attenuatum.*
- *a.* Buccal organ.
- *b.* Gizzard.
- *c.* Commencement of the intestine.
- *d.* Nervous ganglia.
- *e.* Tegumentary follicle; respiratory?
- *f.* Tegumentary gland.

Fig. 2. Anterior extremity of *Streptostomum agile.*
- *a.* Buccal organ.
- *b.* Gizzard.
- *c.* Commencement of the intestine.
- *d.* Portion of the anterior ovary.
- *e.* Follicle; respiratory?

Fig. 3. Anterior portion of the body of *Thelastomum appendiculatum.*
- *a.* Buccal organ.
- *b.* Gizzard.
- *c.* Intestine.
- *d.* Diverticulum of the intestine.
- *e.* Portion of the anterior ovary.

Fig. 4. Ovum of *Thelastomum appendiculatum.*

Fig. 5. Group of *Ascaris infecta*, adhering by their mouths to a shred of epithelium, from the ventriculus of *Julus marginatus.*
- *a.* Male.
- *b.* Female.

Fig. 6. Outline of *Streptostomum gracile.*

Fig. 7. Anterior portion of the body of *Streptostomum gracile.*
- *a.* Buccal organ.
- *b.* Gizzard.
- *c.* Commencement of the intestine.
- *d.* Portion of the anterior ovary.
- *e.* Phytoid filaments growing from the integument.

Fig. 8. Anterior extremity of *Hystrignathus rigidus.*
- *a.* Papilla of the mouth.
- *b.* Buccal organ.
- *c.* Spinous appendages.

Fig. 9. Anterior extremity of *Hystrignathus rigidus.*
- *a.* Buccal organ.
- *b.* Gizzard.
- *c.* Commencement of the intestine.

Fig. 10. Posterior extremity of *Hystrignathus rigidus.*
- *a.* Posterior portion of intestine.
- *b.* Rectum.
- *c.* Anus.
- *d.* Portion of the posterior ovary.

Fig. 11. Position of copulation of *Ascaris infecta.*
- *a.* Male.
- *b.* Female.

Fig. 12. *Streptostomum agile*, with *Enterobryus elegans* and *Arthromitus cristatus* growing upon it.
- *a.* Buccal organ.

b. Gizzard.
c. Intestine.
d. Oviduct filled with ripe ova.
e. Rectum.
f. Anus.
g. Tail.
h. *Enterobryus elegans.*
i. *Arthromitus cristatus.*

Fig. 13. Anterior extremity of *Thelastomum labiatum.*
a. The lobed lip.
b. The buccal organ.

Fig. 14. Portion of the female generative apparatus of *Ascaris infecta.*
a. Ovary.
b. Pyriform commencement of the oviduct.
c. Mass of ripe ova, viewed by reflected light.
d. Termination of the anterior oviduct, in outline.
e. Uterus, with an ovum at its termination, viewed by transmitted light.
f. Spermatheca.
g. Vagina.
h. Generative aperture.

Fig. 15. Tail of *Streptostomum agile*, with a growing thallus of *Enterobryus elegans* (*a*).

Fig. 16. Portion of the body of the male of *Ascaris infecta.*
a. Intestine.
b. Testicle.

Fig. 17. Posterior extremity of the male of *A. infecta.*
a. Intestine.
b. Testicle.
c. Penis.

Fig. 18. Spermatophori of *A. infecta.*

Fig. 19. One of the spiculæ of the penis of *A. infecta.*

Fig. 20. Outline of the posterior extremity of *A. infecta*, exhibiting the ventral tubercles.

Fig. 21. Alimentary canal of *Julus marginatus*, magnified two diameters.
a. Conglomerated salivary glands.
b. Tubular salivary glands, at their terminal portion.
c. Œsophagus.
d. Proventriculus.
e. Biliary tubes.
f. Fatty band.
g. Ventriculus.
h. Large intestine.
i. Rectum.

Fig. 22. Young of *Ascaris infecta.*

Fig. 23. Young of *Thelastomum attenuatum.*

PLATE VIII.

Fig. 1. A transverse fold of the ventriculus of *Passalus cornutus*, with numerous hair-like appendages covered with granulo-filamentous phytoid matter, and bunches of *Cladophytum* and *Corynocladus*.

a. Mucous membrane.
b. Hairs.
c. Phytoid substance.
d. *Cladophytum comatum*.
e. *Corynocladus radiatus*.
f. *Arthromitus cristatus*.

Fig. 2. Portion of the mucous membrane of the ventriculus of *Julus marginatus*, with patches of granulo-phytoid matter growing upon it.

a. Patches of granulo-phytoid matter.
b. Harder nuclei of phytoid matter.
c. Bunches of *Cladophytum comatum*.
d. *Arthromitus cristatus*.
e. Epithelial surface.
f. Basement-membrane.

Fig. 3. Portion of *Enterobryus elegans*, with two large bunches of *Arthromitus cristatus*, and a tuft of *Cladophytum*.

Fig. 4. Portion of *Enterobryus elegans*, overgrown with profuse bunches of *Arthromitus cristatus*.

Fig. 5. Summit of a hair-like appendage, from which grow numerous filaments of *Arthromitus* and other finer phytoid filaments, from the ventriculus of *Passalus cornutus*.

Fig. 6. Summit of a primary cell of *Enterobryus elegans*, from which grows a bunch of *Cladophytum comatum*.

Fig. 7. Two branches of *Cladophytum*, exhibiting minute ramuli.

Fig. 8. Bunch of *Cladophytum comatum*, and several long filaments of *Arthromitus* growing from a portion of the mucous membrane of the ventriculus of *Julus marginatus*.

PLATE IX.

Fig. 1. Represents a portion of the inner surface of the ventriculus of *Passalus cornutus*, with its numerous hair-like appendages enveloped in a parasitic, granulo-filamentous, phytoid substance.

a. Light shading, representing the bottom of the sacculi of the ventriculus, furnished with short hairs.
b. Broad transverse folds of the mucous membrane, between the sacculi.
c, *d*. Longitudinal folds separating the sacculi, and presenting on each side, between the position of the transverse folds, a column of closely-set, simple, bidentate, and tridentate corneous spines.
e. Long hair-like appendages, which border the ventricular sacculi and become the nuclei of large masses of growing phytoid matter.
f. Short hairs, everywhere studding the mucous membrane, and also enveloped with phytoid matter.

Fig. 2. Portion of a transverse fold of mucous membrane, from between the ventricular sacculi of *Passalus cornutus*, with its hair-like appendages enveloped in phytoid matter exhibited of the natural colors.

a. Mucous membrane.
b. Hair-like appendages.
c. Granulo-filamentous phytoid matter.
d. Bunches of *Cladophytum*.
e. Bunches of *Corynocladus*.

PLATE X.

Fig. 1. *Corynocladus radiatus*, from the ventriculus of *Passalus cornutus*.

a. Trunk.

b. Clavate branches.

c. Investment of granular phytoid matter; sporular?

d. Arthromitous filaments.

Fig. 2. Extremity of a branch of *Corynocladus*, very highly magnified, exhibiting the manner in which adhering matter appears dimly shaded, consisting, probably, of spores of the plant.

Fig. 3. Three filaments of a doubtful nature, whether vegetable or part of the animal structure of the ventriculus of *Passalus cornutus*, formerly called, by me, *Cryptodesma tenuis*.

Fig. 4. Polyspore? from the ventriculus of *Polydesmus granulatus*, found mixed with the food.

Fig. 5. Inferior portion of another individual from the same situation.

Figs. 6, 7. Polyspores? found mixed with the food in the ventriculus of *Passalus cornutus*.

Fig. 8. Ergot, *Ergotætia abortifaciens?* found in the proventriculus of *Acheta nigra*.

Figs. 9–12. In dead individuals of *Julus marginatus*, within the ventriculus and large intestine, I frequently observed a fungus in the form of small, white, translucent, compressed, spheroidal bodies, growing upon the mucous membrane, or upon dead filaments of *Enterobryus* lying upon the mucous membrane. The centre of these bodies was depressed, and the surface covered with fine longitudinal striæ, intersected by short transverse striæ. By reflected light, they resembled minute bleached shells of Echini. They measured from the $\frac{1}{1500}$ to the $\frac{1}{300}$ of an inch broad. Upon pressure, they burst or dehisced into several leaf-like finely-striated lobes, and exuded a clear but faintly granular liquid.

Fig. 9. Two of the fungous bodies, just described, viewed by reflected light.

Fig. 10. A group of the same bodies growing upon a filament of *Enterobryus*, also viewed by reflected light.

Fig. 11. One of these bodies viewed by transmitted light.

Fig. 12. One of these bodies burst into six leaf-like lobes from pressure.

Fig. 13. A polyspore? from the large intestine of *Julus marginatus*.

Figs. 14–21. Fungous sporuli, in various stages of development, found in the fecal contents of the large intestine of *Salamandra erythronota*, *S. salmonea*, *Triton niger*, *etc.* They are probably found in the cloaca of all the Salamanders.

Fig. 14. Much more highly magnified than the others.

Figs. 18, 20, 21. In outline.

Figs. 14–17, 19.

a. Granular matter.

b. Transparent liquid.

Fig. 22. Fungus mycelium, found growing in the cloaca of *Triton niger*.

a. Colorless liquid.

b. Granular contents.

c. Nuclei.

d. Phytoid filaments, at the basis of which was a quantity of adherent granular matter.

The small isolated lines represent a species of *Bacterium*, which existed in vast numbers.

Fig. 23. Fungus developed from the spores of Figs. 14–21, and the mycelium, Fig. 22, upon the dung of Salamanders when exposed to the external air. A species of *Torula*, or perhaps *Briarea?*

a. Spores.

b. Spores in outline.

c. Receptacle.

d. Mycelium.

Fig. 24. Portion of mycelium, with contained spores, of the same fungus as Fig. 23.

a. Spore.

b. Spore in outline.

c. Mycelium.

d. Shrivelled portion of mycelium.

Fig. 25. Spores found upon the dung of Salamanders.

Fig 26. Fungoid body found within the ventriculus of a hybernating larva of *Arctia Isabella.* Probably the tissue of some fungus, which may have served the animal as food.

Figs. 27, 28. Fungus mycelium, from the vagina of *Cicada septendecim.*

Fig. 29. Spores from the same situation as Figs. 27, 28.

PUBLISHED BY THE SMITHSONIAN INSTITUTION,
WASHINGTON, D. C.
APRIL, 1853.

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

MEMOIR

ON THE

EXTINCT SPECIES OF AMERICAN OX.

BY

JOSEPH LEIDY, M. D.

[ACCEPTED FOR PUBLICATION SEPTEMBER, 1852.]

COMMISSION

TO WHICH THIS PAPER HAS BEEN REFERRED.

Paul B. Goddard, M. D.,
Joseph Pancoast, M. D.

Joseph Henry,
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INTRODUCTION.

Fossil remains of the ox tribe have been frequently discovered in the United States, of which descriptions, scattered through various works, have been given; but no approach to a correct view has been obtained of the number and character of the extinct species. The author, having the best opportunity of inspecting most of the specimens which have been described, has availed himself of it to give in this Memoir as clear a history of the animals as the remains would justify. In this endeavor, he has been very much assisted by the examination of additional specimens, in the cabinets of the American Philosophical Society and Academy of Natural Sciences of Philadelphia; and others, loaned with the utmost liberality by the Boston Natural History Society; Prof. Samuel St. John, of Hudson, Ohio; Mr. J. W. Foster, and Mr. Thomas Kite, of Cincinnati; to all of whom he now expresses his sincere thanks.

The ox tribe is surpassed by no other in economical importance to man, and it is also one of peculiar interest to the naturalist and geologist. The existing species are numerous, and are indigenous to all the continents excepting South America and Australia.

America, at the period of its discovery by Europeans, possessed no indigenous species of horse; although the New World presented such favorable conditions to the existence of this animal, that, a few years after its introduction, it formed large herds, now found in a wild state. This is a remarkable fact, especially as recent researches have proved the former existence of at least two species in North and South America.

The non-existence of any species of ox indigenous to the latter continent is, however, still more remarkable; for, not only are the conditions so favorable to its development at the present time, that the Domestic Ox introduced by Europeans exists in immense herds upon the extensive pampas in a wild state, but there are also found two species indigenous to North America. Nor have any remains of extinct species of ox been found in South America, while such have been discovered in North America, indicating the former existence of three and probably four

species; and it really appears as if circumstances had always been absent upon the former continent, which have been at least coincident with the primitive origin of the ox tribe in other countries.

Of Australia, we know too little to say positively no species of the ox tribe has ever existed there *ab origine;* and it would probably even be unsafe to infer from a view of its recent fauna that there did not.

The two recent species of ox of North America are the *Bison Americanus*, Gray, and the *Ovibos moschatus*, Blainville.

When North America was first colonized by Europeans, the *Bison Americanus*, or Buffalo, ranged over nearly the whole continent; but it has gradually retired westward in advance of the migrating column of the white race of man, until it has entirely disappeared west of the Mississippi. To find it now, in large numbers, it is necessary to travel far west of the latter, even to the foot of the Rocky Mountains; and the day is not far distant when it will become quite extinct, unless protected by a munificent republic, as has been done by the Emperor of Russia in the case of the Aurochs, or European Bison, now kept in great herds in certain forests of Lithuania.

The *Ovibos moschatus*, or Musk Ox, is rarely seen by travellers and naturalists, being confined to that part of America west of Hudson's Bay, and north of 65° of latitude, to which climate it is peculiarly adapted by its thick long fleece.

A fine specimen of this animal, preserved in the British Museum, we are informed is the only one contained in any collection of Europe or this country.

CHAPTER I.

GENERAL REMARKS.

§ 1. Fossil Remains of the American Buffalo, Bison Americanus.

Remains of the American Buffalo are frequently discovered within the circuit of its former habitation east of the Mississippi, more especially at that remarkable cemetery of mammalia, Big-bone Lick, Kentucky. Mr. Lyell, in the description of a recent visit to this locality,[1] remarks that, within the memory of persons now living, the Buffaloes crowded to the springs of Big-bone Lick; but they have retreated for many years, and are now as little known to the inhabitants as the Mastodon itself. In reference to the same place, he observes he saw remains of the Buffalo in great number in a superficial stratum cut open in the bank of the river.[2]

In the Museum of the Academy of Natural Sciences there is a collection of bones from Big-bone Lick, which I do not hesitate to attribute to the Buffalo; although, from no recent skeleton, excepting crania, of this animal being accessible for comparison, I cannot positively ascertain their identity.

The specimens are as follow:—

1. Fragment of the left side of the lower jaw, containing the last molar tooth.

2. Fragment of the left side of the lower jaw containing four teeth, from an old individual.

3. The occipito-parietal and temporal bones of a young individual.

These three specimens were presented to the Academy by Dr. Richard Harlan.

4. Two superior molar teeth; presented by Thomas Fisher, Esq.

Besides the foregoing, there are numerous bones from Big-bone Lick, presented by Thomas Jefferson to the American Philosophical Society, and now on deposit in the museum of the Academy. The specimens are dark-brown or black in color, with a lustrous surface, and are dense and unaltered in their texture. The interior of the long bones is filled with a hard, dry, pulverulent, chalk-like adipocire.

They are as follow:—

1. A dorsal and a lumbar vertebra, and a sacrum of five pieces belonging to an individual not quite adult. They are about the size of those of the Domestic Ox. The epiphyses are separated from the bodies of the two vertebræ and lost. The pieces of the sacrum are firmly anchylosed together, but the first piece has lost its anterior epiphysis.

[1] Travels in North America (1845), vol. ii. p. 55.

[2] Ibid. p. 56.

2. A radius about as large as in the common ox.

Length internally	11½ inches.
Breadth of proximal articulation	3½ "
" distal "	3¼ "
Circumference at middle	4½ "

3. Two metacarpals of the right and left foot of two different individuals, about as long as, but broader than in the common ox.

Length	8 inches and 8 inches 3 lines.	
Breadth of proximal articulation	2 "	11 lines and 3 inches 1 line.
" distal "	3 "	and 3 inches 3 lines.
Circumference at middle	5 "	2 lines and 5 inches 7 lines.

4. Three metatarsals about as long as in the common ox, but narrower.

Length	9 inches 3 lines.
Breadth of proximal articulation	1 inch 10 "
" distal "	2 inches 3 "
Circumference at middle	3 " 11 "

5. Six first phalanges about 2½ inches long.

6. Five second phalanges measuring from 1¾ to 1½ inches in length.

§ 2. General History of the Remains of extinct species of American Ox, which have been previously described.

Remains of extinct species of ox are also quite abundant in the post pliocene deposits of North America.

The first distinct species of extinct American ox was announced to the world by Mr. Rembrandt Peale.[1] It was established upon a fragment of a cranium with a portion of one horn-core attached, which was discovered in the bed of a creek falling into the Ohio River, twelve or fourteen miles north of Big-bone Lick, and was presented to the American Philosophical Society by Dr. Samuel Brown, of Kentucky, and is now deposited in the museum of the Academy of Natural Sciences.

Notwithstanding the greater size of the specimen as compared with the corresponding part of the skull of the Aurochs, Cuvier, who subsequently described a cast of it sent to the museum at Paris by Mr. Peale, considered it as having belonged to the same species,[2] and in this view he has been generally supported by succeeding writers on the subject. It is, however, exceedingly doubtful, abstractly, whether the same species of Aurochs was ever common to the eastern and western world; and in the absence of any correct evidence to favor such a view, Dr. Harlan

[1] Account of some Remains of a Species of gigantic Oxen found in America and other parts of the World, by Mr. Rembrandt Peale. Philosophical Magazine (1803), vol. xv. p. 325, pl. vi. The latter is a good representation of a posterior view of the specimen.

[2] Ossem. Foss. ed. 4, t. vi. p. 287.

was quite justifiable in proposing for the animal to which the fragment under consideration belonged, the name of *Bos latifrons*.[1]

In the *American Journal of Science* for 1846,[2] Dr. W. M. Carpenter described a portion of a fossil ox skull, and a molar tooth of an old individual, found on the banks of the Brasos River, near San Felipe, Texas, which appear to belong to the same species as that just indicated.

A second species of extinct ox was established, by Dr. Wistar, in the year 1814, upon part of a skull with both horn-cores nearly entire, found at Big-bone Lick.[3] This specimen, and many other remains of mammalia, were obtained through the exertions of Thomas Jefferson, in his zeal for the advancement of science, and presented by him to the American Philosophical Society, which subsequently deposited them in the museum of the Academy of Natural Sciences, that they might be accessible to the inspection of all persons visiting Philadelphia.

To the species indicated by Wistar, Dr. Harlan afterwards gave the name of *Bos bombifrons*.[4]

Mr. William Cooper, in a communication entitled "Notices of Big-bone Lick,"[5] observes, that he found a second head of this species among a collection of bones discovered by Mr. Finnell at Big-bone Lick, much in the same state as that figured by Dr. Wistar.

A third extinct species of ox found in North America was first indicated by Dr. De Kay, from a fragment of a skull with portions of both horn-cores attached, which was ejected by the shock of an earthquake in 1812, at New Madrid, on the banks of the Mississippi, and was presented to the Lyceum of Natural History of New York by Dr. S. L. Mitchell.[6]

Under the impression that the specimen belonged to the same species of ox as two crania described by Pallas,[7] and a third by Ozeretskovsky,[8] for which no name had been proposed, Dr. De Kay designated this as the *Bos Pallasii*, and provisionally referred his specimen to the same species;[9] which is, however, without doubt, incorrect, as will be seen hereafter.

Mr. Cooper states that, during his stay at Big-bone Lick in 1828, a mutilated skull of this species was found at that place and brought to him, and is now deposited in the collection of the Lyceum of Natural History. He also adds he saw another specimen of the same species from Ohio.[10]

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[1] Fauna Americana, p. 273.
[2] N. S. vol. i. p. 245.
[3] Trans. Amer. Philos. Soc. n. s. vol. i. p. 381.
[4] Fauna Americana, p. 271.
[5] Am. Month. Journ. of Geol. vol. i. p. 173.
[6] An. Lyc. Nat. Hist. vol. ii. p. 280.
[7] Nov. Comment. Petrop. vol. xvii. p. 606.
[8] Mém. Acad. de St. Petersb. vol. iii. p. 215.
[9] An. Lyc. Nat. Hist. vol. ii. p. 291.
[10] Am. Month. Journ. of Geol. vol. i. pp. 173, 174.

CHAPTER II.

DESCRIPTIONS OF EXTINCT SPECIES OF AMERICAN OXEN.

BISON, Ham. Smith.

In the skeleton of the genus *Bison*, the skull presents the most important characters, by which it may be distinguished from *Bos* and extinct species may be recognized. As in *Bos*, the horn-cores are on a level with the orbits behind, but they come off an inch or more in advance of the inion. In *Bison*, the forehead is broad, quadrate, and slightly convex. It has no trace of lachrymal fossæ.

BISON LATIFRONS, Leidy.

Great Indian Buffalo, Peale: Philos. Mag. Vol. XV. p. 325, Pl. VI.; Hist. Disq. on the Mammoth, p. 84.
———, Faujas-Saint-Fond: Essai de Geol. I. 347; An. du Mus. II. p. 192.
Aurochs, Cuvier: An. du Mus. Vol. XII. p. 382, Pl. 34, Fig. 2; Ossem. Fos. IV. p. 50, Pl. III. Fig. 2; Ed. 4, t. 6, p. 287, Pl. CLXXIII. Fig. 2.
Bos latifrons, Harlan: Fauna Americana, p. 273; Med. and Phys. Researches, p. 276; Edinb. New Philos. Journ. XVII. 359; Cooper: Amer. Month. Journ. of Geol. Vol. I. p. 174; De Kay: An. Lyc. Nat. Hist. of New York, Vol. II. p. 286; New York Fauna, Zool. Pt. 1, p. 110.
Urus priscus, Bojanus: Nov. Act. Acad. Nat. Cur. XIII. 427.
Great fossil ox, Godman: Amer. Nat. Hist. Vol. III. p. 243, Pl.
Bos priscus, H. v. Meyer: Nov. Act. Acad. Nat. Cur. XVII. p. 141; Giebel: Fauna d. Vorwelt, I. p. 153.
Fossil ox, Carpenter: Am. Journ. of Science, n. s. Vol. I. p. 245.
Bison latifrons, Leidy: Proc. Acad. Nat. Sci. Vol. VI. p. 117.

The *Bison latifrons* is established upon the fragment of cranium before referred to, presented by Dr. Samuel Brown to the American Philosophical Society.

The specimen consists of the hinder portion of the cranium with a fragment fourteen inches in length of the left horn-core (Plate I.), and indicates a species as large as the existing Arnee, or Buffalo (*Bubalus buffelus*, Gray), of India and Java.

The sutures of the remaining bones of the specimen are anchylosed; but the positions of the frontal and fronto-parietal sutures are yet distinguishable as slightly elevated zigzag lines (Fig. 1).

The form of the cranial fragment with its attached portion of horn-core is almost a repetition of the corresponding part of the skull of the Buffalo.

The base of the horn-core is situated five inches in a curved line outwards and forwards, or two inches and a half in a straight line, in advance of the position of the occipito-parietal crest.

The forehead is slightly more flat antero-posteriorly than in the Buffalo, arising from the occipito-parietal crest, being a little less below its level.

The lateral margins of the inion are broken away in the specimen; but the

remaining portion exhibits the same appearances in detail as in the Buffalo, though in an exaggerated degree corresponding to its much greater size (Fig. 2).

The base of the specimen is very much broken, but that which is preserved indicates the form to have been the same as in the last-mentioned animal.

The occipital condyles are alike in both, and, at their anterior part, advance in a concave manner to the posterior muscular protuberances of the basilar process. Between the condyles and paramastoid, a large deep fossa exists, having at its inner side the foramen condyloideum.

The foramen magnum occipitis is slightly wider than high, being two inches one line by one inch eleven lines.

The basilar process in the fossil, at its posterior muscular protuberances, is four inches wide and two inches and a quarter at those joining the body of the sphenoid.

The os tympanica has been large and inflated, as in the Buffalo, and a portion of one glenoid articulation remaining in the specimen presents the same form as in the latter.

Admeasurements.

Breadth of forehead between the bases of the horn-cores	15	inches.
Height of the inion from the upper edge of the occipital foramen	5½	"
Circumference of the horn-core at its base	20½	"
Circumference of the horn-core ten inches from its base	17½	"

As before observed, the fragment of a fossil ox head and molar tooth, described by Dr. W. M. Carpenter, also belong to the *Bison latifrons*.

The cranial specimen, Dr. Carpenter states, consists of the frontal bone with portions of the horn-cores. From one broken extremity of the latter to the other, the measurement is fifty-six inches; the right portion being two feet, the left eighteen inches in length. The base of the horn-cores is seventeen inches in circumference, and at the distance of eighteen inches from the head fourteen and a half inches. The frontal bone is nearly plane, and between the horn-cores, which arise laterally from the same level, is fourteen inches in breadth. The horn-cores are nearly cylindrical; and from the wood-cut representing the specimen, are directed outwards, a little backwards, and slightly upwards.[1]

The tooth found with the above specimen, Dr. Carpenter observes, is a second true molar of the upper jaw of the left side. The crown is worn down nearly to the fangs, and the characteristic ruminant triturating surface is nearly obliterated. The antero-posterior diameter of the crown is a little over an inch and a half, and the transverse diameter is an inch and a sixth.

In the cabinet of the Academy of Natural Sciences there are preserved five molar teeth, about one-third larger than those of the Buffalo, which I am disposed to consider as having belonged to the *Bison latifrons* (Plate II., Figs. 2—7).

[1] Dr. Carpenter says "forwards," but, from the cut, he evidently means upwards.—*Am. Journ. of Sci.* vol. i. 1846, p. 245.

All the specimens are from the vicinity of Natchez, Mississippi. Two of them were found by Dr. M. W. Dickeson in association with remains of *Mastodon*, *Equus*, *Ursus*, *Cervus*, *Megalonyx*, and *Mylodon;* the others belong to the American Philosophical Society, to which they were presented by W. H. Huntington, Esq., who discovered them in association with remains of *Mastodon*, *Equus Americanus*, and the jaw of *Felis atrox*, described by me in the Transactions of the latter Society.

Three of the teeth are superior molars; one, the last of the series (Plate II., Fig. 4), is unworn, the others are moderately so. The inferior molars are both the last of the series; and one is unworn, while the other is worn down within half an inch of the fangs, which are elongated, as is ordinarily the case in the teeth of old ruminating animals.

In the upper molars the external side exhibits six folds relatively not more prominent than in the common ox. Internally between the principal lobes, the accessory column is very well developed and robust (Figs. 2, 4). The crescentic enamel pits or islands of the grinding surface are more simple than in the ox, and appear relatively more capacious as a result of their greater simplicity or less degree of inversion of the sides of the pits (Fig. 3).

The last lower molar (Fig. 5) also presents a well-developed accessory column between the anterior pair of principal lobes externally, and in the worn down specimen (Figs. 6, 7), upon the triturating surface forms a correspondingly larger fold. In the unworn specimen, the summit of the posterior lobe bifurcates anteriorly, one portion joining the postero-internal fold of the middle lobe, the other the postero-external angle of the same lobe.

Admeasurements of the Teeth.

Unworn superior last molar:	
Length	36 lines.
Antero-posterior diameter externally	20½ "
Transverse diameter at the middle of the tooth anteriorly	14 "
Transverse diameter at bottom	17 "
Two superior true molars, probably first and second:	
Length	30 and 33 "
Antero-posterior diameter	18 "
Transverse at middle	13 "
Unworn inferior last molar:	
Length	36 "
Antero-posterior diameter	25 "
Transverse	9½ "
Worn inferior last molar:	
Length of crown	6 "
Antero-posterior diameter of triturating surface	25 "

This last specimen appears somewhat water-worn and rolled. A portion of the anterior fangs are broken off, and the posterior, which is now fourteen lines long, is partially worn away.

J. Hamilton Couper, Esq., of Darien, Georgia, presented to the Academy of Natural Sciences an os humeri and a tibia found in excavating the Brunswick Canal, in Georgia. The specimens are well preserved in their texture, are hard and lustrous, and brown in color. The former has its upper extremity broken off, and the head of the tibia is somewhat mutilated. They belonged to a species of ox considerably larger than the Buffalo, and probably belong to the *Bison latifrons*.

The os humeri is of the right side, and measures nine and a half inches in circumference at the middle of its shaft, and four and a half inches in breadth at the condyles.

The tibia, also of the right side, anteriorly, from the summit of the spinous process of its proximal articulation, is eighteen inches in length, and the distal articulation is three and a half inches in breadth.

Mr. Couper also presented to the Natural History Society of Boston, an atlas and a metatarsus of an extinct ox found in the same locality as the preceding specimens. They have been kindly loaned to me by the Society, for examination. They are perfect, are dense and heavy, and black in color, and if they do not belong to the same individual as those just described, they, at least, probably belonged to the same species.

The atlas is about one-fifth larger than in the common ox, but it does not fit the condyles of the specimen, which has been described, of the cranium of *Bison latifrons*, being a little too small. Its exact measurements are as follow:—

Breadth transversely	9¾ inches.
Breadth of transverse processes; greatest, obliquely and antero-posteriorly	6 "
Diameter of the spinal canal posteriorly, nearly	2¼ "
Depth from spinous process to front tuberosity of the body	4½ "

The metatarsus is of the right foot, and is about an inch longer than those attributed to the Buffalo from Big-bone Lick, and is one-third more robust. Its measurements are as follow:—

Length	10¾ inches.
Breadth of proximal articulation	2¾ "
" distal "	3 "
Circumference at middle	5½ "

BISON ANTIQUUS, Leidy.

Proc. Acad. Nat. Sci. Vol. VI. p. 117.

This species is proposed with some hesitation upon the greater portion of a right horn-core, with a small fragment of the os frontis attached (Plate V., Fig. 1). The specimen indicates an animal intermediate in size to the recent *Bison Americanus* and the *Bison latifrons*, as characterized in the preceding pages. It was found at Big-bone Lick in association with remains of the recent Buffalo, and belongs

to the Jefferson collection deposited by the American Philosophical Society in the cabinet of the Academy.

The specimen is rather too small to determine positively whether it is a distinct species or not from *Bison latifrons*. It did not belong to an aged individual, as the suture is still open between the frontal bone and that portion of the parietal which forms the upper boundary of the temporal fossa. It belonged to a species of *Bison*, as indicated by the advanced position of the horn-core, and resembles more the corresponding part in the *Bison priscus* of Europe, as represented by Cuvier and others, than it does that of *Bison latifrons*. The horn-core is more abruptly conoidal, and relatively more curved than in the latter. It is not improbable, however, that the fragment may have belonged to a female of *Bison latifrons*. The only characteristic measurements to be obtained from it are as follow:—

Length of the fragment of horn-core	10 inches.
Circumference on a line with the basal margin inferiorly	14½ "
do. five inches from the basal margin superiorly	10 "

BOOTHERIUM, Leidy.

This is a new genus proposed in the Proceedings of the Academy of Natural Sciences, upon two species of extinct ox of North America. Its diagnostic characters, so far as they have been ascertained, are distinct, and briefly as follow:—

1. The os frontis rises into a hump, or forms a prominent process, from the sides of which arise the horn-cores.

2. The latter arise above and posterior to the orbits, but considerably in advance of the inion, and curve downwards in their course, but do not turn up at the tips, as in *Ovibos*.

3. The species possess lachrymal depressions, or larmiers, as well developed as in cervine animals.

Bootherium is closely allied to the Musk Ox, *Ovibos moschatus*, Blainv.; and probably, like the latter, the species were clothed in a long fleece, and inhabited the great valley of the Mississippi, just anterior to the drift period. The genus occupies a position intermediate to *Bos* and *Ovis*.

BOOTHERIUM CAVIFRONS, Leidy.

Bos Pallasii, De Kay: An. Lyc. Nat. Hist. of New York, Vol. II. p. 280, Pl. VI.; New York Fauna, Pt. I., Zool. p. 110; Cooper: Amer. Month. Journ. of Geology, Vol. I. p. 173; Harlan: Med. and Phys. Researches, p. 276; Edinb. New Phil. Journ. XVII. 359; H. v. Meyer: Nov. Act. Acad. Nat. Cur. XVII. 1835, p. 155; Giebel: Fauna d. Vorwelt, I. p. 154.

Bos bombifrons: Proc. Am. Assoc. Cincinnati, 1851, pp. 179, 235.

Bootherium cavifrons, Leidy: Proc. Acad. Nat. Sci. Vol. VI. p. 71.

Through the kind recommendations of several friends, Professors Baird and Agassiz, and Mr. W. S. Vaux, Mr. Thomas Kite, of Cincinnati, Ohio, brought with him to Philadelphia for my inspection, in the spring of 1852, an excellent specimen of the cranium proper of an extinct species of ox, to which I have given

the above name. It is well preserved, compact, heavy, and brown in color from the infiltration of oxide of iron (Plate III., Figs. 1, 2; Plate IV., Fig. 1). Mr. Kite discovered the specimen in the hut of an Indian, in which it was used as a seat, and he was informed it was found in a neighboring gravelly bluff, near Fort Gibson, on the Arkansas River.

Compared to the cranium proper of the American Buffalo, it is relatively higher and narrower. The inion is also relatively higher and narrower (Plate III., Fig. 2).

The bases of the horn-cores, instead of being placed on a line with the orbits posteriorly, as in the Bison and Domestic Ox, are elevated above them, as in the Musk Ox. They are also united together on the top of the head, forming a very remarkable process, covering the os frontis like a huge exostosis (Plate III., Fig. 1). This process extends from within ten lines of the inion the entire length of the os frontis, or four inches anterior to the bases of the horn-cores, and two inches posterior to them. Its length is ten and a half inches, and between the horn-cores it is five and a half inches wide, and anterior to them five inches. At its posterior extremity (Fig. 2), it is one and three-quarter inches thick, and at its anterior border about half an inch. The whole process is remarkably rough and tuberculated, and presents, in some degree, the appearance of an exostosis, the result of disease. Its upper surface is depressed into a concavity, deepest between the horn-cores and divided at bottom by a prominent median ridge. Laterally, the frontal process is continuous with an elevated rough ridge curving in a sigmoid manner beneath the base of the horn-cores. About the middle of its course this ridge comes in contact with the post-orbital ridge proceeding backwards from the post-orbital arch.

The horn-cores project outwards, downwards, and forwards. They are demi-conoidal; being flattened on their antero-superior surface the whole length, but in a most marked degree at the basal and distal third. The latter portion of the horn-core has a slight twist directing the flat surface more upwards. The under or convex surface of the horn-cores is marked by deep vascular grooves, and others corresponding to ridges of the inner parietes of the horns. The flat surface is relatively smooth except near the tip, where it is also marked, though in a less degree, by grooves corresponding to ridges of the horns.

The inion (Plate III., Fig. 2) is seven and a quarter inches in height from the upper margin of the occipital foramen to the top of the frontal process, or four inches five lines to the parieto-occipital crest. The middle of the latter is constituted by a quadrilateral rough protuberance for the attachment of the ligamentum nuchæ. On each side below the crest is a deep oval muscular impression.

The supra-orbitar margin is situated three inches below the line of the highest part of the horn-cores, which commence above the position of the posterior fifth of the orbital entrance. It is notched at its junction with the lachrymal bone. The latter, one and three-quarter inches antero-internal to the notch just mentioned, forms a deep lenticular depression, or larmier, such as exists in the Deer and Sheep (Plate IV., Fig. 1).

The occipital condyles in the specimen appear to have suffered in some degree

from the wearing influence of running water; but they appear originally to have been more uniformly convex than in the Bison, or they have not been so abruptly bent about their middle. The inferior portion also is very much less inclined outwards from a level than in the latter.

The occipital foramen is absolutely a little less in size than in the Bison, and is almost one inch and a half in diameter.

The base of the paramastoids is thick and pyramidal, and between these and the condyles is a broad shallow concave surface not more than three fourths of an inch deep from the level of the lowest part of the condyles, while in a corresponding position in the Bison a fossa exists at least two inches in depth from the same points of measurement.

The basilar process is three and a half inches wide posteriorly, and is strongly marked by the attachment of the anterior cervical muscles. The prominences just in advance of the condyles are one and a half inches wide, and to their outer side, about ten lines in advance of the condyles, is the foramen condyloideum. Just anterior to the latter, and separated from it by a simple transverse ridge, is the jugular foramen, and in advance of this is the os tympanica, not at all inflated, but presenting an irregular crest continuous from the base of the paramastoid inwards and forwards to the side of the basilar process, and there terminating in a short compressed conoidal apophysis. Immediately internal to the latter is the foramen lacerum, and from this the groove is continuous to the inner side of the pterygoid processes, for accommodating the Eustachian tube.

The stylal depression is a cylindrical pit half an inch deep and in diameter.

The auditory process commences in a vaginal apophysis, continuous with the os tympanica, forms the anterior wall of the stylal depression, and has an oblique position outwards, backwards, and upwards. Its anterior surface is concave, and its lower margin presents a groove, passing outwards from the stylal depression, bounded on each side by a ridge, the anterior of which is acute and continuous with the margin of the vaginal process. Between the paramastoids, stylal pit, and auditory process is the stylo-mastoid foramen.

The meatus auditorius externus is longitudinally oval, and is situated about twenty lines above the level of the lowest part of the basilar process.

The glenoid articulation is, in a trifling degree, less convex than in the Bison, is about two and a half inches in breadth, and one and a half antero-posteriorly, and is on a level with the upper part of the meatus auditorius externus.

The post-glenoid tubercle is compressed conoidal, with a slight twist, and is longer than in the Bison.

The glenoid foramen is circular, about two lines in diameter, and occupies a position immediately outside of the post-glenoid tubercle.

The root of the zygoma, at its outer margin, projects considerably external to the position of the base of the horns. Its upper surface above the glenoid articulation presents a large deep concavity, above which, posteriorly, are two large foramina.

The space between the glenoid articulation and the root of the zygoma is much narrower than in the Bison, and the foramen rotundum is less advanced, being on a line with the anterior face of the post-glenoid tubercle.

The process formed by the conjunction of the temporal, sphenoidal, and frontal bones, at the inferior limit of the temporal fossa, is very much larger and more prominent than in the Bison.

The supra-orbitar foramen is placed about twenty lines within the supra-orbital margin.

The temporal fossa (Plate IV., Fig. 1), is relatively more superficial than in the Bison, but is more oblique in its course forwards and downwards, and has a greater breadth from the base of the horn-core to the root of the zygoma.

Admeasurements.

From middle line of os frontis to the tip of the horn-core above	16	inches,	6	lines.
Length of posterior curve of horn-core	15	"	6	"
Greatest distance between the bases of the horn-cores above	5	"	6	"
Antero-posterior diameter of base of horn-cores	4	"	6	"
Vertical " " "	3	"		
Circumference at base	12	"	6	"
" three inches from the base above	10	"		
Greatest breadth of head at the supra-orbitar margins	9	"	6	"
From occipital condyle to the lachrymal margin of the orbit	11	"		
Height from basilar process to summit of frontal process at the inion	9	"		
Breadth at the glenoid articulations	8	"	6	
Length of temporal fossa	6	"	6	"

The specimen of the cranium of an extinct ox, described by Dr. De Kay, before referred to, without doubt belongs to the *Bootherium cavifrons*. From its mutilated condition, the concavity of the frontal process was suspected as being the result of the removal of the whole of the external plate of the os frontis, and the species was supposed to be the same as that indicated by two heads described by Pallas,[1] and one by Ozeretskovsky.[2]

One of the specimens of Pallas was discovered on the shores of the Ob, immediately under the arctic circle; the other was found more northerly in the region of Tundra. That described by Ozeretskovsky was obtained at the mouth of the Yana, between the Lena and Indigirska.

In the better specimen of those indicated by Pallas, Cuvier[3] says the forehead is flat, and the bases of the horn-cores occupy all the space from the orbits to the occipital crest, and approach on a straight line, leaving not more than a finger's

[1] Nov. Com. Petrop. xvii. p. 601; Nov. Act. Petrop. i. 2, p. 243.

[2] Mém. de l'Acad. de St. Petersburg (1810), iii. p. 215, tab. 6.

[3] Ossem. Fos. ed. 4, t. vi. p. 313.

breadth between them, and adds that it would be difficult to distinguish this cranium from that of the recent Musk Ox.

Of the specimen described by Ozeretskovsky, Cuvier is undecided whether to consider it as belonging to the same species of the latter or not, but a simple inspection of Ozeretskovsky's figures, reproduced in Cuvier (Plate CLXXII., Figs. 6 and 7), proves a very close relationship with the recent Musk Ox, and indicates a very distinct animal from *Bootherium cavifrons*, as represented in the figures of the cranium, in Plates III., IV. of this memoir. At a glance, it will be observed that in the former, the horn-cores approach very near each other along their bases, and turn up at their tips like in the Musk Ox, while in the latter, the horn-cores are widely separated at base, and do not turn up at the tip.

Among a large collection of bones and teeth of the Mastodon from Benton County, Missouri, purchased by the American Philosophical Society, and deposited in the Academy of Natural Sciences, I have observed the cranial portion proper of the head of three individuals of *Bootherium cavifrons*, agreeing in all the details with the specimen just described. With them, also, there are fragments of five horn-cores of the same species.

All these Missouri specimens are much decomposed, being exceedingly friable, white, and chalk-like. They are much mutilated, but all the cranial fragments still possess the remains of the remarkable frontal process, and, in one specimen, this verges close upon the inion, and in that position is two and a half inches in thickness.

In the collection of the Boston Natural History Society, I observed a specimen consisting of the posterior part of the cranium with portions of both horn-cores of *Bootherium cavifrons*, which was discovered in the alluvium of the Kentucky River, a tributary of the Ohio River, in Kentucky, and was deposited with the Society by Mr. J. W. Foster.

Through the kindness of Professor Baird, I have received, for inspection, from Professor Samuel St. John, of Hudson, Ohio, a much water-worn fragment of a cranium with one horn-core attached, of the same species, which was found in Trumbull County, Ohio.

Thus have been indicated portions of the crania, of at least twelve individuals of *Bootherium cavifrons*, all found in the great valley through which flows the Mississippi with its tributaries. And from the number of remains, it is probable that this animal, at a former period, fed in vast flocks upon the rich prairies of the valley and the fertile banks of its streams.

Accompanying the fragments of crania and horn-cores of *Bootherium cavifrons*, from Missouri, above described, were two astragali and a metacarpal bone in the same condition of preservation as the former specimens, and no doubt belonging to the same animal.

The astragali have their surface much disintegrated, and, in their present state, measure about three and a quarter inches in their long diameter, and two inches in their breadth.

The metacarpal bone is also much injured upon the surface.

Its measurements are as follow :—

Length	9	inches,	7	lines.
Breadth at the proximal articulation	3	"	4	"
" distal "	3	"	5	"
Circumference at middle	6	"	3	"

Among the collection of Jefferson from Big-bone Lick, there is a specimen of a right metacarpal in perfect condition, which may also probably belong to *Bootherium cavifrons*, although it is a little larger than that last described. It is not improbable that it might belong to *Bison latifrons*.

Its measurements are as follow :—

Length	10	inches,	3	lines.
Breadth at proximal end	3	"	9	"
" distal "	3	"	7	"
Circumference at middle	6	"	4	"

A metatarsal bone and a first phalanx, in the collection of Jefferson, probably also belong to this species. The former is of the left foot, and is a little shorter and considerably less robust than the corresponding bone from Georgia, attributed to the *Bison latifrons*.

Its measurements are as follow :—

Length	10	inches.		
Breadth of proximal articulation	2	"	3	lines.
" distal "	2	"	7	"
Circumference at middle	4	"	9	"

The phalanx measures three and a quarter inches in length.

BOOTHERIUM BOMBIFRONS, Leidy.

———, Wistar: Trans. Amer. Phil. Soc. n. s. Vol. I. p. 359.

Bos bombifrons, Harlan: Fauna Americana, p. 271; Med. and Phys. Res. p. 275; Edinb. New Phil. Journ. XVII. 359; Cooper, Smith, and De Kay: Amer. Journ. Sci. XX. 370; Cooper: Am. Month. Journ. of Geol. Vol. I. p. 173; De Kay: An. Lyc. Nat. Hist. II. 286; New York Fauna, Zool. Pt. 1, p. 110; Meyer: N. A. A. Nat. Cur. XVII. p. 143.

Bootherium bombifrons, Leidy: Proc. Acad. Nat. Sci. Vol. VI. p. 71.

The only characteristic specimen which I have seen of the *Bootherium bombifrons*, is that first described and figured by Dr. Wistar from the collection of Jefferson. It consists of the cranium proper, with both horn-cores attached, and presents the ordinary condition of preservation of all the preceding bones described from the morasses of Big-bone Lick (Plate IV., Fig. 2; Plate V).

The upper outline of the head of *Bootherium bombifrons*, when viewed laterally (Plate V., Fig. 1), resembles in its posterior rise from the inion and its abrupt declination forward that of the Sheep. The os frontis, instead of forming an exostosis-like process, as in *Bootherium cavifrons*, rises gradually from its commencement anteriorly, and forms a sort of hump, from the sides of which, like

in the last-mentioned species postero-superiorly to the orbits, the horn-cores arise. The highest portion of the os frontis is between the posterior part of the bases of the horn-cores, and in this position is elevated over two inches above the line of the supra-orbitar margin. Anteriorly to this most elevated part, the os frontis inclines at an angle of about 45°, but posteriorly has a less degree of inclination. The apex is transverse, obtuse, and impressed at the middle. The parieto-frontal surface is quadrilateral, about four inches square, moderately convex, and presents a broad shallow impression at its central part.

The horn-cores curve outwards, downwards, and slightly forwards. They arise about three and a half inches in a curved line from the inion, or about two and a half in a straight line. They are elongated, conical, curved, and longitudinally furrowed.

The inion (Plate V., Fig. 2) is about four inches in height above the occipital foramen, and in its details corresponds pretty closely with *Bootherium cavifrons*.

The relative position of the orbits to the horn-cores is the same as in the species just mentioned. The supra-orbitar margin is about two inches below the highest part of the base of the horn-cores, and these commence anteriorly about the posterior sixth of the entrance of the orbits. At its anterior third, the supra-orbital margin is deeply notched, and the supra-orbital process upon the upper or frontal surface, about an inch and a half from the margin, is pierced by three foramina arranged in an antero-posterior row.

In advance of the orbit, the lachrymal bone is depressed into a remarkably deep fossa, or larmier, which appears to have been hemispherical, but, in the specimen, the lower portion is broken away (Plate IV., Fig. 2). At the orbital margin, below the larmier, a deep, broad, lachrymal groove exists, as in *Bootherium cavifrons*.

The temporal fossa presents nearly the same degree of inclination as in the latter, and also has the same relative degree of shallowness and length and breadth of surface which this has in comparison with that of the Buffalo.

The ridge, which in *Bootherium cavifrons* proceeds from the frontal process laterally, beneath the base of the horn-core, is but very feebly developed in *Bootherium bombifrons*.

The base of the cranium, though much mutilated, is sufficiently well preserved to exhibit the peculiarities which associate it in the same genus with *Bootherium cavifrons*. The foramina and processes have the same relation of position and form. Like in the latter, the occipital condyles appear to have been less bent than in the Buffalo, the paramastoids have been large and robust, and the fossæ between them and the condyles have been superficial also, as in *Bootherium cavifrons*.

The basilar process is broad and strongly marked by processes for muscular attachment.

The form of the os petrosa, auditory process, and relative position of the meatus auditorius are the same as in *Bootherium cavifrons*.

The post-glenoid tubercle is relatively larger than in the latter, and between it and the auditory process is a pit, into which opens a large foramen, piercing the root of the zygoma, from the temporal surface. Both the pit and foramen exist, but are much smaller, in *Bootherium cavifrons*.

Admeasurements.

From middle line of os frontis to tip of horn-core	12 inches,	6 lines.
Length of horn-core	9 "	
Distance between the bases of the horn-cores	6 "	
Circumference at base of "	8 "	6 "
Greatest breadth of head at the supra-orbitar margins	6 "	4 "
From occipital condyle to lachrymal margin of orbit	8 "	6 "
Greatest height from basilar process to summit of os frontis	7 "	
Length of temporal fossa	6 "	

With the same collection of bones which contained the specimen just described, there is preserved a small metacarpal bone, which I suspect to belong to the same species. It is of the right foot, is an adult specimen, and has the following measurements:—

Length anteriorly	7 inches.	
Breadth of proximal articulation	2 "	4 lines.
" distal "	2 "	5 "
Circumference at middle	3 "	11 "

REFERENCES TO THE PLATES.

PLATE I.

Figs. 1, 2. A portion of the cranium and left horn-core of *Bison latifrons*, one-fourth the diameter of nature.

Fig. 1. Upper view of the specimen.

Fig. 2. Posterior view of the specimen.

PLATE II.

Fig. 1. Posterior view of the right horn-core of *Bison antiquus*, one-third the diameter of nature.

Figs. 2—7. Molar teeth of *Bison latifrons*, the size of nature.

Fig. 2. Inner view of the second superior true molar of the left side.

Fig. 3. View of the masticating surface of the same tooth as the last.

Fig. 4. Inner view of the last superior true molar of the left side.

Fig. 5. Outer view of the last inferior true molar of the left side.

Fig. 6. Outer view of a much worn last inferior molar of the left side.

Fig. 7. Masticating surface of the same specimen as the last.

PLATE III.

Figs. 1, 2. Cranium with both horn-cores of *Bootherium cavifrons*, one-fourth the diameter of nature.
Fig. 1. Superior view of the specimen.
Fig. 2. Posterior view of the specimen.

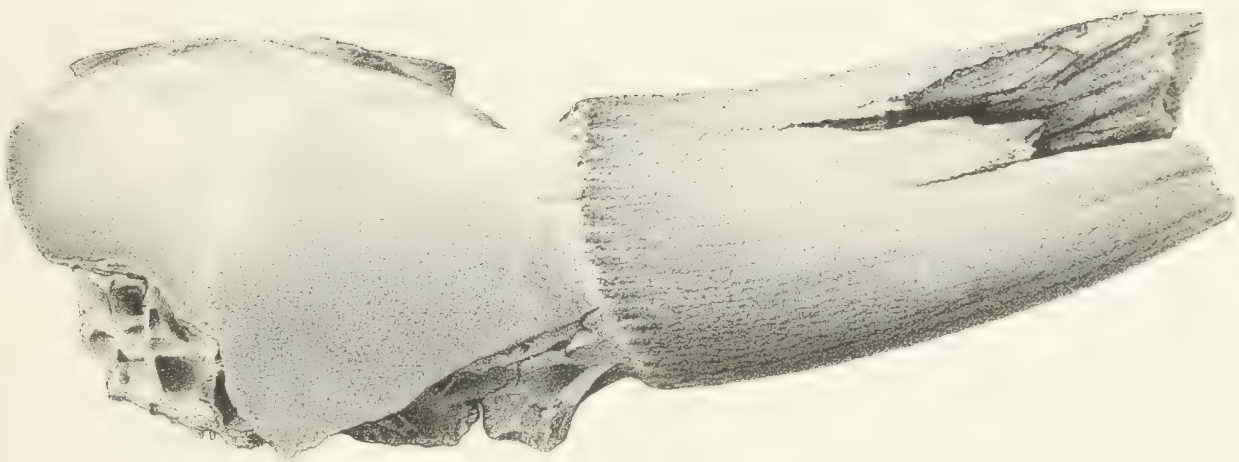
PLATE IV.

Fig. 1. Lateral view of the same specimen of the cranium of *Bootherium cavifrons*, represented in Plate III., also one-fourth the diameter of nature.
Fig. 2. Upper view of the cranium with both horn-cores of *Bootherium bombifrons*, one-third the diameter of nature.

PLATE V.

Figs. 1, 2. Views of the same specimen of *Bootherium bombifrons*, represented in Fig. 2, Plate IV., also one-third the diameter of nature.
Fig. 1. Lateral view of the cranium.
Fig. 2. Posterior view of the cranium.

PUBLISHED BY THE SMITHSONIAN INSTITUTION,
WASHINGTON, D. C.,
DECEMBER, 1852.



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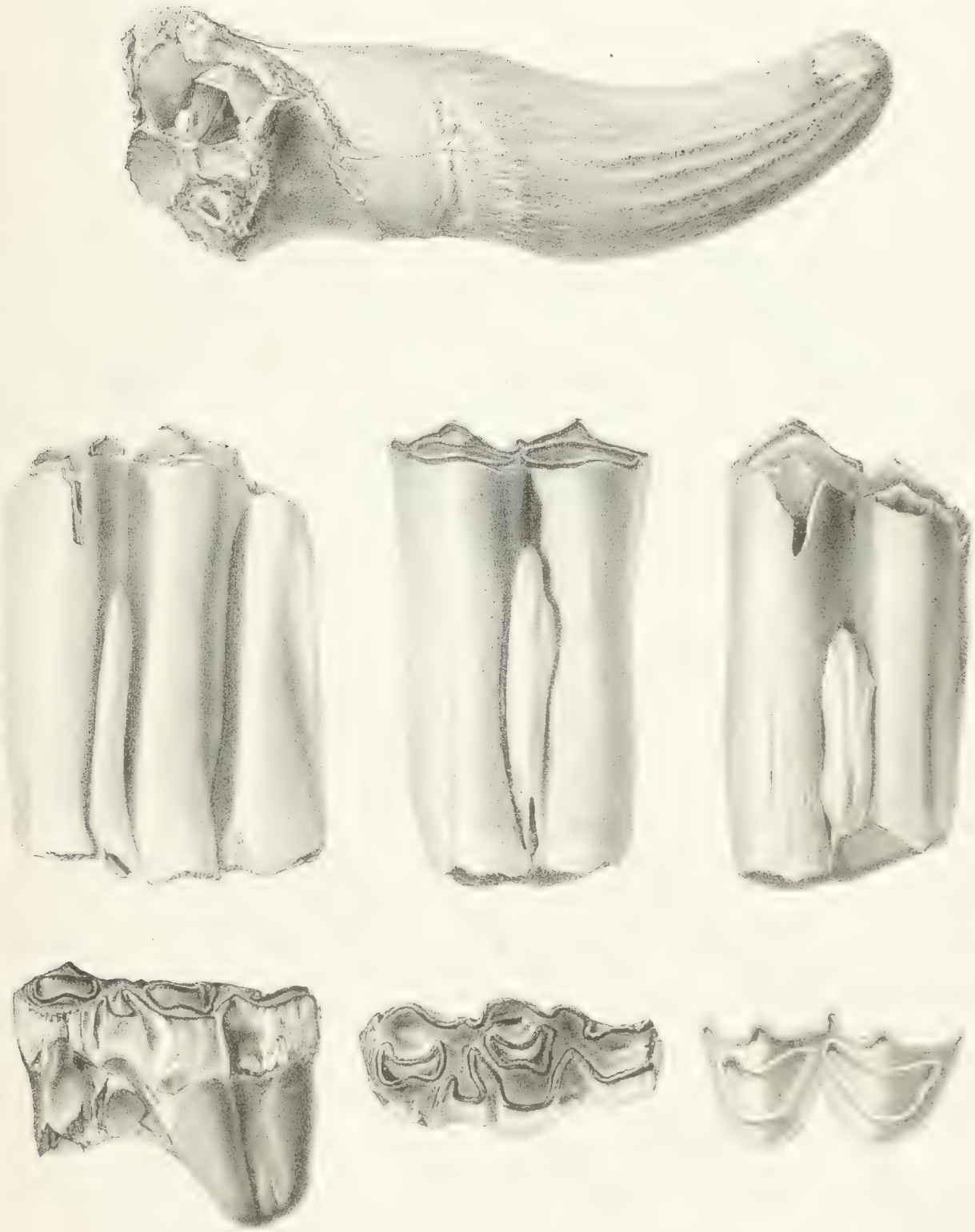

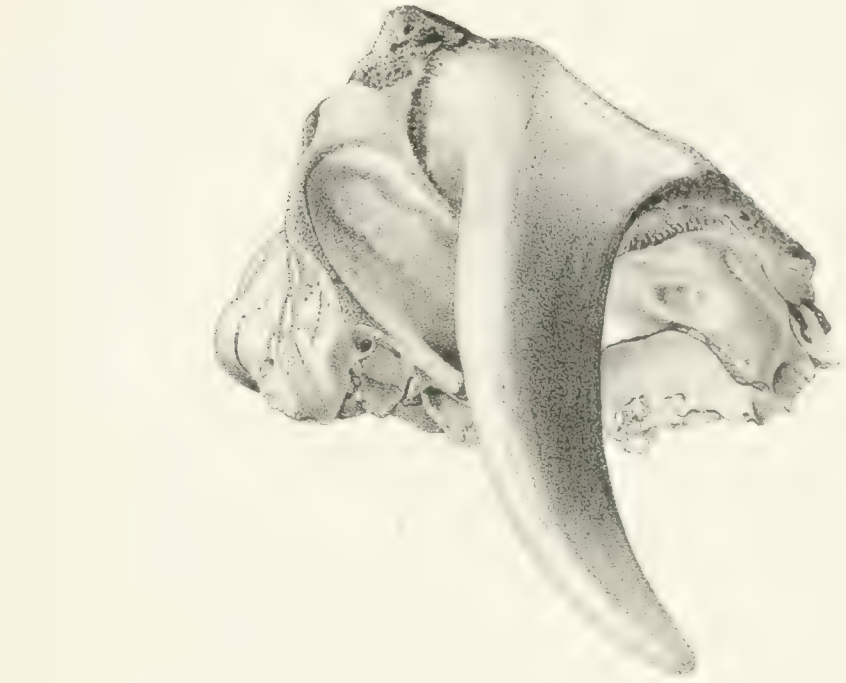

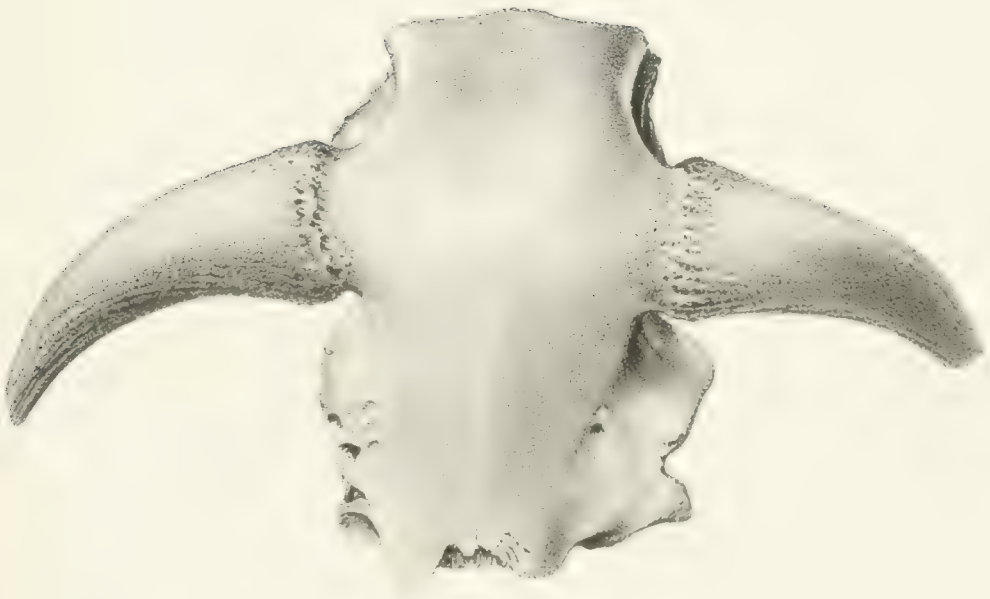

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ANATOMY

OF

THE NERVOUS SYSTEM

OF

RANA PIPIENS.

BY

JEFFRIES WYMAN, M. D.

[ACCEPTED FOR PUBLICATION, MAY, 1852.]

COMMISSION

TO WHICH THIS PAPER HAS BEEN REFERRED.

J. B. S. JACKSON, M. D.

JOSEPH LEIDY, M. D.

JOSEPH HENRY, *Secretary S. I.*

CAMBRIDGE:
METCALF AND COMPANY,
PRINTERS TO THE UNIVERSITY.

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ERRATA.

Page 20, line 25, for "detached," read "detected."
" 23, " 32, " "Bdelostoma," read "Bdellostoma."
" 44, " 1, " "connected," read "covered."

ON

THE NERVOUS SYSTEM

OF

RANA PIPIENS, Lin.

The following memoir comprises an anatomical description of the nervous system of a single species of Batrachian Reptiles, one of the largest existing representatives of the Anourous group. The peripheral portion especially is described somewhat in detail; likewise some of the changes which it and the nervous centres undergo during the process of metamorphosis. A comparison is made between the temporary conditions of some of the organs, as observed in the young, with the permanent conditions found in the class of Fishes, from which it appears that there exists a more complete analogy between some of the anatomical conditions of this class and the larvæ of Batrachian Reptiles, than has been generally recognized.

In drawing up the descriptive details of this memoir, there are many which have been already noticed in other and allied Reptiles; nevertheless, they are drawn from a species whose anatomy has not as yet been fully described, and which in some respects differs from that of the closely allied species; it is therefore probable, that the want of agreement between the results contained in this memoir and those of other anatomists whose works are quoted, is dependent upon specific differences.

In the details relating to the cranial nerves, there are some facts noticed, which have not only a bearing on their physiology, as in the case of the facial nerve, but upon the philosophical anatomy of the nervous system, and the reduction of all of the cranial nerves, except those connected with the organs of the special senses, to the common spinal type.

The nervous system of Batrachian Reptiles is worthy the attention of the anatomist, on account of the great simplicity of its structure, presenting a condition intermediate between the two extremes of the Vertebrate series, as exhibited by that of the higher Mammals, on the one hand, and that of the Cyclostome Fishes and

Amphioxus, on the other. The spinal chord in the Anourous species exhibits the general peculiarities of the division, and in addition the enlargements corresponding with arms and legs; while the brain is so far reduced in the relative proportion of its different parts, and so far stripped of the "accessory organs of perfection," as to enable the student to obtain with ease a clear conception of the general plan, a conception always so difficult to acquire when studying the brain of Mammals or of Man. In these, the cerebrum and cerebellum so far transcend all the other organs of the encephalon, that the parts which in a morphological point of view are of equal value have been frequently overlooked, as forming either integral parts or primary subdivisions. In Frogs, in common with the lower Vertebrates, while no one part takes an excessive development, there is at the same time no one of the fundamental ones either wholly deficient, or so far reduced as to deprive the general plan of any of its more important features.

In making a dissection of the cerebro-spinal axis, when the canal in which it is lodged is laid open, one of the peculiarities which first attracts the eye is the existence of a whitish substance deposited in a somewhat irregular manner, but principally on the sides and around the veins, extending through the whole length of the canal and into the cranium, where it is especially abundant in the neighborhood of the optic lobes. Occasionally it will be found in such quantities as materially to embarrass the anatomist in his dissections, and at other times only traces can be detected. Under the microscope this substance is resolved into vast numbers of minute crystalline forms, consisting of calcareous matter, and similar to those hereafter to be described in connection with the spinal nerves, where it is found lodged in peculiar capsules, and in which the quantity is more constant.

After the chord is completely exposed, one of its most striking features, when compared with the same part in other Reptiles, except Anourous Batrachians, is its shortness. (Plate II. Fig. 1.) The point at which the last pair of spinal nerves is given off is just beyond the middle of the trunk, that is, at about the seventh or eighth dorsal vertebra. Beyond this the chord is continued only in the form of a slender thread, which has been compared to a ligament, though it contains the microscopic elements of the chord, but at the same time giving off no nerves, and is lodged and terminates in the long and slender coccyx. In other Reptiles, on the contrary, in Saurians, Chelonians, Ophidians, and Urodel Batrachians, the chord is continued as such to the extremity of the spinal canal, giving off its pairs of nerves nearly opposite to the intervertebral foramina which correspond to them. While it has this exceptional shortness in the adult of the Anourous species, it is of great interest to notice the fact, that, in their embryonic condition, they conform more nearly to the general rule, as was long since shown by Serres,* by numerous other observers after him, and as will be seen in the sequel of these pages; nevertheless, as will be shown hereafter, this caudal portion does not conform precisely to the true spinal type. The subdivisions of the central axis into brain and spinal chord, and of these into subordinate parts, are enumerated in the following tabular view.

* E. R. A. Serres, Anat. Comp. du Cerveau dans les Quatres Classes des Anim. Verteb. Paris, 1829.

CENTRAL AXIS. — Plate I.

BRAIN. — Figs. 1–9.		SPINAL CHORD. — Fig. 1.	
I. Olfactory Lobes	A.	I. Medulla Oblongata	I.
II. Cerebral Lobes	B.	II. Brachial Enlargement	L.
III. Corpora Striata	C.	III. Crural Enlargement	N.
IV. Optic Thalami	D.	IV. Coccygeal Portion	O.
V. Pineal Body	E.		
VI. Pituitary Body	F.		
VII. Optic Lobes	G.		
VIII. Cerebellum	H.		

With the exception of the corpora striata, which are lodged and concealed in the cavities of the cerebral lobes, all the parts above enumerated may be seen without dissection, from a merely superficial examination. When stripped of their membranes, and examined in a recent state, there is a striking contrast between the brain and chord as regards color; the first having a grayish semitransparent, almost gelatinous appearance, whilst the second is opaque and whitish, the latter color, however, being traceable to a certain extent in the interior of the cerebral masses. Black pigment-cells are to be seen scattered over the general surface of the brain and spinal chord, but are especially abundant about the optic lobes, which are much darker than the cerebral lobes.

Section I. — The Brain.

I. *Olfactory Lobes.* (Plate I. Figs. 1–9, A.) — These form the anterior portion of the cerebral mass, but are so intimately connected with the cerebral lobes, that they might be supposed to form with them one and the same pair of organs, and have been sometimes described as such. The only mark of separation from the cerebral lobes is a slight constriction at the line of contact, visible both on the under and upper surface, though farther back in the latter than in the former; consequently, when seen from below, the olfactory lobes appear relatively larger than from above. A condition of things rarely met with, perhaps only in a few Anourous Batrachians, is the fusion of the right and left olfactory masses, with scarce a trace of any indication that they are double organs. In Toads they are likewise fused, but are separate in *Siren* and *Menobranchus*. (Fig. 5.) This union of the olfactory lobes, however, is analogous to what occurs in the cerebral lobes of Sharks and other Plagiostome Fishes, and in the optic lobes of the *Lepidosiren*, and as it seems in *Menobranchus*. Their fusion is a subject of additional interest, since it tends to show that they are developed from a single embryonic vesicle, and not from a pair of vesicles. If this statement be true, then we have the olfactory lobes arrested in their development, previous to the division of this vesicle. An analogous state of things is easily shown in a chick of the fourth day, where the optic lobes form a single vesicle, though they subsequently become double and widely separated from each other. In *Lepidosiren*, according to Owen, there is but one optic lobe, and that on the median line; we may therefore regard this last as the vesicle

undivided. The fusion, or rather the absence of separation, of the cerebral lobes of Plagiostome Fishes, is undoubtedly to be explained in the same manner.

It should be remembered that the olfactory lobes are not represented in the primitive divisions of the embryonic brain, but are either the result of a transverse subdivision, or perhaps of an offshoot in the form of a hernia from the cerebral lobes. Bearing this in mind, we have an explanation of the union of each olfactory with its corresponding cerebral lobes and with its fellow, in Frogs, which is simply the result of incomplete separation or of arrested development.

II. *Cerebral Lobes.* (Plate I. Figs. 1 – 9, B.) — Agassiz, in examining the brains of Fishes, has shown that those of the same natural families sometimes, and of genera often, affect forms which to a certain extent are characteristic, and something analogous to this has been observed by Blanchard to exist in the nervous system of Invertebrates. A comparison of the cerebral lobes of *Siren*, *Menopoma*, *Menobranchus*, *Salamandra*, *Triton*, and *Rana* (Plate I. Figs. 2, 4, 5), will show that in them there exist, though perhaps not strongly marked, certain general characteristic peculiarities, which consist mainly in having cerebral lobes with an elongated form, with sides nearly parallel when seen from above, the anterior being but slightly more narrow than the posterior extremity. In other Reptiles, the cerebral lobes have a more triangular form, the transverse diameter being much greater behind than in front. Measured on the upper surface, each cerebral lobe in the Bull-frog is about two and a half times longer than broad, and the breadth of the two lobes together does not exceed that of the medulla oblongata. They are laterally compressed, so that the height of each lobe is greater than its breadth, and its greatest elevation is at its posterior part. (Plate I. Figs. 3 – 7.) They are separated by a distinct fissure, which may be seen above and below, and which presents this interesting feature, that it extends quite through from the upper to the under surface, being closed in front, however, by the united olfactory lobes, and behind by the mesocerebrum; thus presenting the opposite state of things to that which exists in Rays and some Sharks, where the two are so completely fused, or, perhaps more correctly, have been so little subdivided, still retaining one of their embryonic features, as to have the appearance of a single lobe. This extended separation between the cerebral lobes, though but little noticed, certainly exists in many other Vertebrates. Cuvier speaks of it in Birds, where "it is apparent that they are distinct throughout their whole height, and that they are united to each other behind, near the anterior commissure of the brain." * Bojanus, in his admirable figures of the anatomy of *Testudo Europæa*, represents a similar separation between the cerebral lobes, though it is not referred to in the descriptions of the plates. His Figs. 88 and 89 show the two hemispheres disjoined as far as the crura cerebri. Agassiz, in the *Anatomie des Salmonés*, Table V. Fig. 5, has represented a longitudinal section of the brain of *Salmo fario*, in which it appears that the "olfactory lobes" (cerebral lobes, cerebral hemispheres of other anatomists), as well as the "olfactory tubercles" (olfactory lobes of others), are likewise wholly separated from each

* Cuvier, Leçons d'Anat. Comp., 3me edit., Tom. III. p. 113.

other. This complete separation of these lobes in the animals above referred to, is certainly an interesting anatomical feature, as bearing upon the physiology of the parts, and tending to prove the existence of complete duality of function; for it can hardly be supposed that two organs so completely separated could be any more mutually dependent than the two eyes or two ears; each is the seat of its own functions and processes, though the functions of the two sides are doubtless precisely similar.

The closing up in front of this fissure between the cerebral lobes, by the united olfactory lobes, leaves an opening through the brain from above downwards, and this might at first sight be compared to the ring which transmits the œsophagus in the Invertebrate animals. If this comparison be allowed, it would afford some support to the doctrine, which assumes a homology between the nervous centres of the Vertebrate and Articulate divisions of the animal kingdom. The question of the correctness of such a comparison will necessarily present itself in the course of the following descriptions, and the remarks we have to make upon it may be not improperly presented here.

Although frequent attempts have been made to homologize the nervous systems of Vertebrates and Articulates, yet in reality there seems to exist no correct basis on which the alleged homology may rest. Among the earlier advocates of this view were Gall and Spurzheim, but a more able advocate was found in Geoffroy St. Hilaire. Still more recently, the doctrine has been revived, at least in part. In the recent edition of his General and Comparative Physiology, Dr. Carpenter seems to recognize the homology of certain portions, at least, of the nervous systems of Articulates and Vertebrates, though in others he admits simply an analogy; after stating that there is nothing in the Articulates homologous with the cerebrum and cerebellum of the Vertebrates, he says, "The first subœsophageal ganglion, which has been likened to the latter (the cerebellum), being really *homologous*, as the distribution of its nerves abundantly proves, with the medulla oblongata." * In speaking of the spinal chord, he says, "It consists of a continuous tract of gray matter inclosed within strands of longitudinal fibres, and it may thus be regarded as *analogous* to the ganglionic chain of the Articulates." If there be any homology, it seems to us as if the whole nervous system of the Articulates, as far as it is developed, should be homologous with a corresponding portion of that of the Vertebrates. If the subœsophageal ganglion is homologous with the medulla oblongata, that which follows it should be homologous with the spinal chord. There seems sufficient ground for the belief, that all homology between the nervous systems of the two divisions is as much contraindicated, as between their skeletons or their muscular systems. If a true homology existed, we ought at least to have representatives from the Articulates and Vertebrates, in which the identity would be obviously proximate, if not absolute. But as yet there has been described no instance where the spinal chord, structurally considered, is fairly and distinctly represented in the Articulates, nor among Vertebrates any true ganglionic chain with an

* Gen. and Comp. Phys., 3d edit., p. 1017.

œsophageal ring through which the œsophagus passes. The existence of separate lateral halves of the spinal chord in the Vertebrate embryo has been adduced as evidence of identity. Has there, however, ever been seen an embryo of a Vertebrate in which there were developed on the lateral halves of the spinal chord itself, distinct and separate ganglionic masses united with the masses above and below them by nervous fibres only? It is true, as already stated, that in many Vertebrates distinct enlargements of the chord correspond with the attachments of the different pairs of spinal nerves; but still, in these instances, the chord never loses its vertebrate type; there is always at least, even in *Amphioxus*, an uninterrupted mass of cell substance occupying the entire length of its centre, and this substance in all other Vertebrates is inclosed in two half-sheaths of longitudinal nerve tubes. The likeness recognized between the subœsophageal ganglion and medulla oblongata is *physiological*, but not anatomical; and physiology, all philosophical observers agree, does not teach us homology. The wings of Birds and Insects, physiologically considered, are corresponding parts; but not so as anatomical structures. On the other hand, the tongue of the Giraffe, of the Woodpecker, the Chameleon, and the Lamprey, anatomically considered, are identical parts, are homologous with the organ ordinarily subservient to taste, but, physiologically studied, are appropriated to widely different uses. Thus the subœsophageal ganglion may be, as regards its functions, the analogue of the medulla oblongata, an analogy, however, which the pure anatomist, independently of experiment, would never discover.

Professor Owen, in speaking of the interspace in Fishes "produced by the divarication of the main lateral columns of the encephalon," through which passes the membranous tube (infundibulum) connected with the hypophysis, asks, "Is this vertical slit homologous with the encephalic ring perforated by the œsophagus of the Invertebrata?" * The homology in this case appears to be opposed by the fact, that the slit in question in the Fish opens *in front* of the optic lobes, which last, if there be any homology between the nervous systems of Vertebrates and Invertebrates, would be the homologues of the supraœsophageal ganglia which give off the optic nerves. The slit should therefore be behind, and not in front of these lobes.

It is contended that the homology between the nervous centres of Vertebrates and Articulates is contraindicated by the following facts: — 1st. The brain and spinal chord are enveloped in a common sheath, the vertebral column and its contained membranes, and are never in the same cavity with the viscera, even in the embryo; while the ganglionic chain is lodged and developed in the common cavity with the organs of organic life. 2d. In Vertebrates the spinal chord is always on the back, and the ganglionic chain always on the abdominal side in the Articulates. 3d. One consists of a continuous mass of both tubular and vesicular structure, while in the other the vesicular structure is interrupted. 4th. The œsophageal ring, with the œsophagus inclosed, never exists in Vertebrates, but is always present in the Articulates, in common with nearly all other Invertebrates. 5th. The embryonic conditions of the two systems do not at any period clearly assimilate each other.

* Lectures on Comparative Anatomy, Vol. II., Fishes, p. 181.

6th. Two parts, to be homologous, must be structurally and morphologically similar, and not simply the seat of similar processes.

III. *Corpora Striata.* (Plate I. Fig. 7, C.) — The parts supposed to be homologous with these ganglia are but very imperfectly developed, and present themselves in the form of small nodules in the interior of the cerebral lobes, and will be again referred to in connection with the ventricles and the internal configuration of the brain.

IV. *Optic Thalami.* (Plate I. Figs. 1 – 9, D.) — Behind the cerebral lobes the encephalon becomes slightly contracted, and its breadth, as seen from above, is formed wholly by two solid bodies, separated from each other by a distinct fissure in front, but behind united by commissural fibres. (Fig. 6, D.) The fissure communicates with a cavity between them. Their position immediately behind the cerebral lobes, as well as their relation to the part next to be described, to the optic lobes and the optic nerves, indicates that they are the homologues of the thalami optici of Mammals and Birds.

V. *Pineal Body.* (Plate I. Figs. 2, 7, 9, 11, 12, E.) — This occupies its usual position between the optic thalami, is situated at their anterior extremity, and almost concealed by the cerebral lobes. It is a small reddish body, the presence of which is not easily determined, since it is covered with a loose areolar tissue, which unites it to the investing membranes, and consequently is usually torn off in removing them. It is sustained by a membranous pedicle, but has no "peduncles." Its minute structure is quite different from that of the same part in the higher Vertebrates, and might reasonably lead us to doubt as to its homology; in truth, independently of its position, this would not be suspected. Under the microscope it has something of the form of a mulberry, and is highly vascular. Each of the rounded projections on its surface is supplied with a loop of a bloodvessel, all the loops being derived from two or three principal trunks. (Plate I. Figs. 11, 12.) Externally it is invested with a layer of ciliated epithelium. Within the epithelial layer, and apparently among the bloodvessels, are scattered rounded cells containing granules, and these bear a close resemblance to the ganglion cells of other parts of the brain. This corresponds with the description of the same part in Fishes, as given by Professor Owen. It is in them a constant appendage of the encephalon, "but is commonly only a vasculo-membranous pyramidal sac continued from the third ventricle. Some medullary matter mingles with the membranous walls in Clupeoid and Cyprinoid Fishes." *

The existence of vibrating cilia on the surface, and of vascular loops within, are points in which this body resembles the choroid plexus of the brains of Mammals as described by Valentin; but as its position is extra-ventricular, we have no authority for identifying it with that organ. The cilia on its surface seem to indicate that its function, in part at least, is to set in motion the fluids secreted by itself or some of the adjoining parts.†

* Owen, *op. cit.*, Vol. II. p. 180.

† *Comparative Anatomy of the Pineal Body.* — It exists, according to Cuvier, in all Fishes, in the form of a small globe of gray matter, very distinct in the common Eel and the Conger, less apparent in other

VI. *Pituitary Body.* (Hypophysis; Plate I. Figs. 1, 3, 7, 8, F.) — This organ is as universally present in the Vertebrate series as the preceding, and its function is equally unknown. In Frogs it forms a very distinct portion of the encephalon, is situated beneath the optic lobes at a short distance behind the optic nerves, and is of an oval form with its greatest diameter in a transverse direction; it has a short, hollow membranous infundibulum, which is its only attachment to the base of the brain, and is consequently easily separated by very slight force, when the orifice communicating with the ventricular cavity is easily seen. A body which has received the name of *tuber cinereum* is found between it and the decussation of the optic nerves, forms a slight projection from the under surface of the brain, and constitutes the floor of the third ventricular cavity; it is not, however, sufficiently well defined to be regarded as a distinct organ.

VII. *Optic Lobes.* (Plate I. Figs. 1, 2, 6, 7, 8, G.) — In consequence of their form and breadth, the optic lobes are the most conspicuous portions of the brain, and, after the cerebral lobes, the largest. They consist of a pair of oval ganglia flattened on their upper surface, their longest diameter being directed outwards and forwards, and on the median line, where the two come in contact and are united, they are flattened, as it were, by mutual pressure. When seen from beneath (Fig. 1, G), they make a prominent projection on either side of the pituitary body and the tuber cinereum. After the pia mater has been removed, the optic tract can readily be seen in its passage to the optic thalami and optic lobes. (Plate I. Fig. 1.)*

VIII. *Cerebellum.* (Plate I. Figs. 2, 3, 6, 7, 8, H.) — Immediately behind and in part covered by the optic lobes, is the cerebellum; which, when compared with the same organ in the higher Vertebrates, presents a more striking contrast than do either of the other cerebral masses with their respective homologues. In Batrachians generally, the cerebellum does not seem to have passed beyond the minimum of development for the class of Reptiles, an inferiority similar to that met with in *Petromyzon* and *Ammocœtes* among Fishes. It consists of a flattened transverse band of cerebral substance, continuous on either side with the medulla oblongata; its posterior border is slightly elevated (Figs. 7, 8, H), and forms the

species, and is inserted between the "hollow lobes" (generally regarded as the optic lobes) and the "anterior (or cerebral) lobes," by two small, either vascular or membranous medullary chords. (*Leçons*, Tom. III. p. 135.) In the *Salmonidæ*, according to Agassiz, the pineal body consists of a plexus of very slender vessels interwoven and anastomosing with each other, so as to form a club-shaped mass attached to a slender pedicle. (*Anat. des Salmonés*, p. 132.) According to Serres (*Anat. Comp. du Cerveau*, Tom. II. p. 483), in *Squalus squatina* "it surpasses all the proportions which it is known to have in the other classes." He also states, that "it is universally present in Fishes, but, in order that it may be detected, it must be examined under water." In Tortoises it is much more distinct than in Frogs, is easily detected, but having apparently the same vascular structure that it has in Batrachian Reptiles. Its presence in Mammals and Birds is beyond a doubt, and in the former especially consists of a more solid mass, having many points of structural resemblance to other parts of the encephalon. The calcareous concretions which Soemmering, the Wenzels, Longet, and numerous other observers, have found to exist so often, perhaps in nearly every instance, in the human body, are seldom or not at all found in the other Vertebrates.

* For pathological facts and physiological inferences with regard to the optic lobes, see the description of the optic nerves.

anterior limit of the triangular opening of the fourth ventricle, and beneath it may readily be seen the passage from the fourth to the third ventricle. Attached to its posterior edge, and formed by the folding of the pia mater, is a vascular valve or plexus, which completely covers in this cavity. According to R. Wagner,* the cerebellum "consists, in naked Amphibia and Ophidia, of a hollow medullary layer." In the dissections of Frogs which I have made, I have in no instance been able to verify this statement; for it has always presented itself in the form of a solid body, though the central portion is more transparent than the cortical.

The low degree of the development of the cerebellum in Frogs naturally suggests to us an inquiry as to the nature of its functions, and likewise leads to the conclusion, that, whatever those functions are, they must, on analogical grounds, be supposed to have a low state of activity in comparison with the same organ in those animals in which it is proportionally more largely developed. The low development of this organ in Frogs and Cyclostome Fishes is certainly at variance with either of the more generally received theories entertained by physiologists of the present time; namely, those of Gall and Spurzheim on the one hand, and of Flourens on the other. It would be difficult to reconcile either of them, or perhaps any existing theory, with numerous other facts afforded by comparative anatomy, all of which tend to show a vast disproportion, at least, between the size of the cerebellum and the activity of the functions of which it is alleged to be the seat. As regards the theory of sexual instinct, this function is certainly not less strongly manifested in the Lamprey than in ordinary Fishes, as the Trout or the Herring; yet how widely different is the relative size of the organ in the two! Professor Owen has contrasted Lampreys with the Sharks, showing that the difference in the cerebellum of these animals is entirely disproportioned to any known distinction relating to the sexual instinct.† The well-known experiments of Leuret, though perhaps less extended than could be desired, are, as far as they go, wholly opposed to the hypothesis.

Although the experiments of Flourens and his followers tend to show a connection between locomotion and the cerebellum, disturbance of the former usually attending injuries inflicted on the latter, yet his theory that the cerebellum coördinates muscular motions is opposed by numerous anatomical facts, as well as by some of the results of pathology; for out of *ninety-three* cases of lesions of the cerebellum, Andral found but *one* to sustain the theory of Flourens. The necessity for coördinating motions in Frogs, animals moving with four legs, is as great as, if not greater than, in most Fishes, moving solely by the aid of the vertebral column, all their principal motions being produced by its flexion and extension. In *Petromyzon*, with its still more rudimentary cerebellum, we have the power of coördination as great, and muscular activity as intense, during the breeding season at least, when they stem the most rapid currents and ascend falls of water, as in the Trout, the Sucker, or the Pike, which have the cerebellum proportionally much longer. We will take one

* Elements of the Comparative Anatomy of the Vertebrated Animals, p. 150.

† Lectures on Comp. Anat. and Phys. of Vertebrated Animals, Part. II. p. 188.

more illustration of the inconsistency of this theory (and it equally applies to that of Gall and Spurzheim) with facts; we will contrast the organ in question, as it appeared to us in the recent dissection of a Porpoise (*Delphinus phocæna*) and of a Shark (*Carcharias obscurus*). Both of these animals are predaceous, both pursue their prey in the water, both are endowed with great rapidity of motion, both are capable of readily and suddenly changing their direction, and both move by the alternate flexion and extension of the vertebral column; I know of no reason for supposing that the power of coördination is materially different in the two; and in these instances the mass of the body was in the two nearly the same, and yet the cerebellum of the Porpoise is not only relatively, but absolutely, several times larger than the whole encephalon of any known Fish, however large.

In view of such important opposing facts, derived from comparative anatomy and pathology, and of the contradictory results of experiments, one cannot but entertain a doubt that the problem of the functions of the cerebellum is yet solved. The suggestion of Dr. Carpenter, that the middle lobe may be the seat of the sexual instinct, and the lateral lobes of the power of coördination, loses its force when it is remembered, that in Fishes, Reptiles, and Birds even, the lateral lobes either do not exist, or are in a rudimentary condition, entirely disproportioned to the function of coördination. If the size of the organ is any indication of its functional activity, the cerebellum is not proportional to the amount of muscular fibre set in motion, nor yet to the combinations of motions of which animals are susceptible.

Section II. — Internal Structure of the Brain.

An indication of imperfect development of the brain in animals is often found in the existence of cavities in one or more of its principal masses. An immature condition of one mass, however, by no means involves that of all the others. In some Sharks the nearly solid cerebral lobes accompany a hollow cerebellum, and in other Fishes a solid cerebellum and cerebral lobes, as in the Cod, are associated with optic lobes, which are hollow. In Frogs, with the exception of the cerebellum and optic thalami, all the principal masses are hollow, and in this respect manifest but little progress beyond an embryonic condition. The cavities of the cerebral and olfactory lobes communicate freely with each other, though there is no communication between those of opposite sides. The two lobes above referred to, being developed from the same vesicle, do not manifest any separation from each other until some time after the tadpole leaves the egg, and subsequently the distinction between them is only indicated by a slight constriction. (Fig. 6.) The walls of the cerebral lobes are quite thin above and externally. On the inner wall may be seen in each ventricle two projections; the upper and longest corresponding with an external furrow, and which may therefore be regarded, perhaps, merely as a convolution (Fig. 7); and the lower an oval ganglionic body (Fig. 7, C), in which may be seen terminating some of the white fibres prolonged forwards from the spinal chord. This body is solid, and its position in the ventricular cavity, its connection with the white fibres, and its relation to the optic thalami, which are directly behind

it, are all strong indications that it is the homologue of the *corpus striatum*. Behind these bodies is an opening which communicates with the third ventricle (Fig. 8, L), and above this another directed towards and above the optic thalami, and which may therefore be regarded as the fissure of Bichat. The *third ventricle* exists in the form of a fissure between the optic thalami (Fig. 8, M), communicating posteriorly with the fourth ventricle, and above is covered over posteriorly only by commissural fibres. The *optic lobes* (Figs. 6, 7, 8, D) are hollow, and their cavities communicate freely with each other. On removing their upper walls we have brought into view two masses, which are seen from above in Fig. 6, and in section in Fig. 8, which nearly fill the cavity, allowing, however, a passage beneath and between them to the fourth ventricle.

The ventricles of both cerebral and optic lobes are lined with ciliated epithelium, which doubtless serves to keep in motion the secreted fluids of the ventricular cavities, a function in all probability performed by the cilia of the choroid plexus in the higher Vertebrates. Thus we have suggested to us again the old hypothesis of the motion of the fluids contained in the brain, not moved, however, by the so-called cerebral pulsations, but by an agency which, when the theory was first propounded on a purely hypothetical basis, was wholly unknown.

One of the more important features indicating perfection in the brain of the higher animals is the existence of commissures between its different segments on opposite sides. The corpus collosum, or great commissure between the cerebral lobes, does not appear to exist in or below the Marsupials, and the pons Varolii or cerebellar commissure is confined to Mammals. The nearly complete separation of the cerebral lobes in Frogs would seem to preclude the possibility of any thing like a corpus collosum passing from the one lobe to the other. The only commissural fibres which I have been able to trace are those between the optic thalami (Fig. 6, D), just in front of the optic lobes; also between the same parts in the base of the brain.

Although great labor has been expended in attempting to unravel the microscopic structure of the brain in Vertebrates, as yet but little has been accomplished beyond the mere demonstration of the histological elements and their general plan of arrangement. The existence of tubular fibres and of vesicular structure is admitted in the nervous system of both Vertebrates and Invertebrates, but the mode of combination, their precise anatomical relationship, is still unsettled; and until that relationship can be determined, but little progress can be hoped for in the explanation of the mode of the origin and transmission of nervous force. Its determination is no less important to the physiology of the nervous system, than the discovery of the circulation of the blood was to the physiology of respiration or nutrition. Some anatomists, as Hanover, describe the vesicular structure as consisting either wholly or in part of caudate cells, the prolongations of which are either the commencement or termination of nerve tubes; this view has also been more recently maintained by Wagner and Robin. Bidder has described and figured nerve tubes, which seem to dilate into ganglion corpuscles or nerve cells, and then revert to the condition of nerve tubes beyond the cell, so that the cell, accord-

ing to this view, is developed, not necessarily at the beginning or end of a tube, but in its course.* I have not been able to detect such a connection in any observations which I have made on the brains of Frogs. The thin walls of the cerebral lobes of these animals, especially when young, seemed to offer a favorable opportunity to test the correctness of this statement. If a piece, comprising the whole thickness of the upper part of the lobes above mentioned, be placed under the microscope, little else can be seen than the vesicular element, though the section is sufficiently transparent to be viewed through its whole thickness. Here and there a questionable tube may be found, but the principal structure, besides the cells, is that of the capillary vessels, which may be identified by their containing blood discs, and may be frequently traced dwindling into minute empty tubes, which are easily mistaken for nerve tubes. If a piece of a lobe which has been macerated in alcohol be transferred to turpentine, the preparation soon becomes transparent, when its minute structure can be determined. In the cerebral lobes of Frogs thus treated, spherical cells and capillary vessels are easily detected, but no nerve tubes. The longest portion of the whole mass obviously consists of cells, and, after repeated examinations both of adults and embryos, not one has been found presenting the caudate condition. Here, then, at least, we have an instance in which the cells and nerve tubes do not come together, — in which they are not immediately connected; and, as will be seen in the spinal chord, continuity is not necessary for the manifestation of nervous force, nor is contact even. In other parts, as the cerebellum, optic lobes, optic thalami, the tubes and cells are more or less intricately combined, the first forming an interlacement, in the meshes of which the cells are inclosed; but even here no continuity between the two was seen, — not a single instance in which a nerve tube arose from or terminated in a cell. The cells (Fig. 10, Plate I.) are quite uniform in appearance, from whatever part of the brain they may be derived. The only variation is that of size. The cell wall is quite thin, and so easily ruptured, that it sustains but little pressure, and, unless great care be taken to protect it, it will be found quite difficult to obtain a fair view of even a single one. Within, the cell contains numerous minute granules, which fill the larger portion of its cavity, leaving a thin transparent space around the circumference. The *nerve tubes*, whether from the base of the brain or from the chord, are varicose in nearly every instance; and whether this condition be accidental or not, when manipulated with the greatest care, whether viewed with or without pressure, even when perfectly fresh and almost living, they were never seen in any other condition. Every attempt to determine the mode of termination of the nerve tube was unsuccessful. If, however, the views of Wagner and some of the more recent writers be correct, — namely, that, before the nerves terminate, the "white substance of Schwann" disappears, so that the tube contracts and becomes invisible, except with the highest powers of the microscope, — we have in part an explanation of the difficulty. Wagner maintains that these minute tubes are lost on the walls

* Zur Lehre von dem Verhältniss der Ganglien-körper zu den Nerven-fasern. Neue Beiträge von Dr. F. H. Bidder. Nebst einem Anhänge von Dr. A. W. Volkman. Leipzig. 1847.

of the cells. Such, however, cannot be the case in the cerebral lobes, since there are no nerve tubes except at the base of the brain, and these are entirely out of proportion to the cells above them.

Having failed to demonstrate the intimate connection between the tubes and cells, the following general arrangement of the two was nevertheless easily traced, and the more easily from the general absence of commissural fibres in the encephalic masses. The appearance which first of all attracts the eye is the strong contrast of color between the brain and the spinal chord, the first seeming almost gelatinous, and the second of an opaque white, a contrast depending upon the predominance of nerve tubes in the latter and of nerve cells in the former. The white fibres of the chord, as they pass forwards from the medulla oblongata, may be seen entering the different cerebral masses, as indicated in the plan. (Fig. 9, Plate I.) Some of the fibres forming the edge of the fourth ventricle can be traced into the cerebellum, where they extend towards the median line; but few of them reach the posterior edge of this organ, which has the gelatinous appearance of those parts which consist wholly or in a great measure of cells. Other fibres from the lateral portions of the chord are traceable to the optic lobes, on entering which they are crossed by the fibres of the optic nerves, coming from the opposite direction and passing them externally. The remaining portion of the fibres which are continued forwards from the chord pass beneath the optic lobes, and divide into the crura cerebri, where they can be more easily followed by slitting the brain longitudinally; some of them terminate in the optic thalami, and others, quite few in number, and only detected by the microscope, are seen to enter the corpora striata and the outer walls of the base of the cerebral lobes, each crus subdividing in order to reach those parts; finally, the last traces of longitudinal fibres are seen following the base of the brain as far forwards as the olfactory lobes. No portion of the brain contains so many nerve tubes as the optic lobes; they are derived from the two sources above mentioned, namely, the chord and the optic nerves, and within the substance of the lobes the two kinds are so completely interwoven and intermixed, as to render abortive every attempt to unravel them, and determine the existence of a definite plan.

The general result, then, which has been obtained from an examination of the minute structure of the brain, is simply this: — 1st. That each of the cerebral masses is in direct connection with the spinal chord, by nerve tubes extending from the one to the other. 2d. All the longitudinal fibres of the brain appear to be accounted for, in the species here described, by the fibres prolonged from the chord. 3d. With the exception of the optic lobes, the cerebral masses consist mainly of cells, none of which are caudate, and none of which have any visible connection with the nerve tubes. The cells are all nearly spherical, and their contents are granular. 4th. No longitudinal commissural fibres exist, nor any thing analogous to a fornix. 5th. As regards the functions of the cerebral lobes, their bases excepted, whatever force they originate, whatever impulses they transmit, and whatever impressions they receive, all must be effected by the aid of cells alone; these must be both originators and conductors of nervous force.

Section III. — Spinal Chord.

As is almost universally the case in the Vertebrate series, this portion of the nervous system consists of a flattened cylinder terminating posteriorly in a conical extremity, and is partially divided lengthwise by two fissures, one on the upper and the other on the under surface; the latter in Frogs is the most easily traced, and when the membranes are stripped off, the right and left halves readily separate as far as the gray substance. By a glance at Plate I. Fig. 1, it will be at once seen, that there exist in the chord three enlargements or bulgings, I, L, N, at nearly equal distances. The first of these, the medulla oblongata, is almost universally present in Vertebrate animals, being perhaps really deficient in *Amphioxus* only; but the second and third are wanting whenever the arms and legs are not developed, or exist in a rudimentary condition. Among Sauria the genus *Bipes* possesses only the third or crural, and *Chirotes* only the second or brachial enlargement; legs only being developed in the first, and arms in the second.

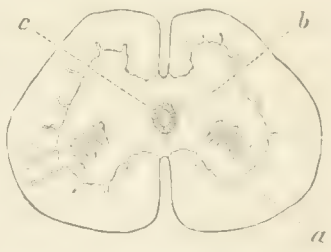
When seen from the abdominal or lower side, as in Fig. 1, these three enlargements have a strong resemblance to each other, and it is at once suggested, that they are serial repetitions of similarly constructed parts. In addition to these, I have noticed in a few instances a slight enlargement of the chord at the origin of each of the pairs of spinal nerves, and from observations made on other animals am inclined to the belief, that a similar condition of the chord exists more generally than anatomists have been disposed to admit, and that there is consequently more truth in the disputed statements of Gall and Spurzheim with regard to this point of anatomy than they have generally received credit for. The enlargements in question are quite obvious in *Menobranchus;* also in *Lophius Americanus*, as stated by Cuvier, though the correctness of this last statement has been called in question by Professor Owen. It is possible, however, that in the European species it may not exist; in the American, it is unequivocally present.

From the second or brachial enlargement is given off a large trunk distributed to the arms, and beyond this a smaller one, which sends a filament to the preceding nerve; the contracted portion of the chord which follows the brachial enlargement gives off the nerves to the walls of the abdomen, and the third enlargement supplies the three lumbar nerves and the minute coccygeal pair. The second and third bulgings present no obvious difference as regards structure, but the principal interest which attaches to them is the proportion between their size and the limbs with which they are connected. It is stated by Cuvier, that they are in proportion to the "force" of their respective limbs. If by force is meant the muscular energy and development of the limbs, this statement does not appear to be sustained in the present instance, nor in many other instances brought to notice by comparative anatomy. In man the brachial enlargement is always larger than the crural, though the legs are so much more powerfully developed than the arms, and the same is true of the greater number of Mammals. In Frogs there is a still greater disproportion between legs and arms, yet

there is not a corresponding difference in the size of the bulgings. They cannot, therefore, be said to be in proportion to the muscular force only of the limbs, but correspond far more nearly to the acuteness of the sense of touch, which in Man and Mammals is more delicate in the hands and arms than in the legs and feet. In Bats, it is true that the muscular force of the arms is greater than that of the legs, and that the brachial far surpasses the crural enlargement; but, at the same time, the sense of touch in the membranes of the wings is exalted to a most extraordinary degree. In Birds the posterior bulging is almost universally the largest, though this condition is in part dependent upon the presence of the rhomboidal sinus. In these animals, while the muscular energy of the wings is the most developed, the sensibility of the feet is the more acute.

A transverse section of the chord, when viewed with a low magnifying power, exhibits the external or white substance forming two crescentic masses, as in Fig. 1, *a*, their concavities turned towards each other and including the gray substance, *b*; this last seems to form the only bond of union between the two sides, (and in this respect agrees with the results of Mr. J. L. Clarke,* from an examination of the chord in Man,) the white columns being quite distinct from each other, and having no commissural fibres either on the anterior or the posterior face. Under the microscope, the white substance is resolved wholly into nerve tubes, and in the gray substance even, these are the most conspicuous element. The largest portion of the white columns consists of longitudinal nerve tubes, intermixed with others which are transverse; some of these last are continuous with the roots of the nerves, and can be seen entering the chord passing towards the centre, and between the longitudinal fibres, but after entering the gray substance are no longer traceable; as shown in Fig. 14, Plate I., some of them appear to join the longitudinal series, but were not traced far enough to determine whether they did not ultimately join the gray substance in their immediate neighborhood.†

Fig. 1.



The gray substance, besides the white fibres which are intermixed with it, is composed in part of cells more or less spherical or polygonal, such as are met with in the brain, and, in addition, of distinct caudate cells, such as are represented in

* Philosophical Transactions, 1851.

† The evidence of the more recent microscopists tends to show that nearly all, perhaps all, of the nerve roots enter the gray substance. A demonstration of this fact, with regard to the posterior roots, is easily made on the spinal chord of a fœtal sheep, where they have the peculiarity of passing over the outer surface of the posterior columns until they reach the median line, when (still on the exterior) they descend into the fissure as far as the gray substance, in which they are wholly lost. Their course is easily traced with a low doublet or even the naked eye. The posterior horn of gray substance reaches the surface, and is traceable as a distinct band throughout the whole length of the chord. In the instances which the writer has examined, none of the sensitive roots were traced into the posterior white columns; but all seemed to encircle them, and enter the gray substance at the bottom of the posterior fissure. According to Mr. Clarke, the posterior roots in Man are traceable *through* the posterior columns into the gray substance.

Fig. 2.

Fig. 2. It is not easy, however, to demonstrate the presence of these last in recent specimens. They may be detected readily, by making thin sections after the chord has been hardened in alcohol, and then treating them in the manner followed by Mr. Clarke.* They are more conspicuous in the posterior horns of the gray substance, where they form a well-defined deposit, some of them being fusiform, others with three or more caudate appendages. After the most careful examination, I have not detected any direct connection between these caudate appendages and nerve tubes, and have not therefore been able to confirm the statement of Hanover and others, that nerve tubes originate or terminate in nerve cells. The deposit of caudate cells just referred to seems to extend through the whole length of the posterior horns of the chord; they were not detected in the anterior horns.

On opening the chord from the back longitudinally, two white tracts or columns are traced through its whole length and continued into the fourth ventricle, on the floor of which they may be seen without dissection; they do not, however, appear to be any thing else, as will be seen hereafter, than the lower extremity of each lateral crescent of white substance, as seen in Fig. 1.

In the sections made and examined according to Mr. Clarke's method, I have always found a canal (Fig. 1, *c*) occupying nearly the centre of the chord; it is lined by a well-defined layer of oval or columnar epithelium cells, inclosing a distinct cavity, which in all probability is filled with serum. This canal is continuous with the cavity of the fourth ventricle. Bischoff, Rokitansky, and others, seem to regard the canal as of only temporary existence in the human body; but Mr. Clarke's observations show that it is constant, and it has been detached in many adult animals; it is therefore highly probable that something of the kind exists generally in the Vertebrate division. Consequently, the opinion of Gall and Spurzheim, as to the existence of a central canal, so long disputed, is fully confirmed.

As already stated, the *medulla oblongata*, when seen in front or on the abdominal side, appears to be a serial repetition of the crural and brachial enlargements. Examined on the back, the resemblance is less striking, there being a fourth ventricle to which there is nothing similar in the other portions. If it has been more generally described in connection with the encephalon, it has been rather from its position in the cranial cavity, than from any marked peculiarity as regards structure, or the kind of function of which it is the seat. When morphologically considered, it is reducible to the common type of the chord, and the more complex condition which it has in the higher animals, in consequence of the existence of the olives and pyramids, is lost in the descending scale.

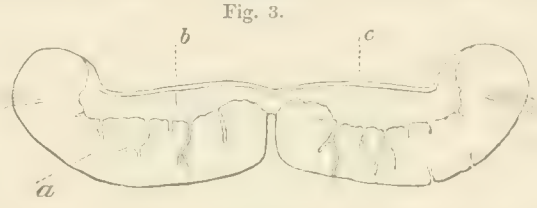
The fourth ventricle is lined with a thin layer of gray substance, *b* (Fig. 3), and this is covered by a layer of epithelium, *c*. The posterior pyramids (Plate I. Fig. 2, L)

* This consists in hardening the preparation in alcohol, and then transferring to a mixture of one part of acetic acid and three parts of alcohol, in which it is left for one or two hours; it is then placed for the same period in alcohol, and finally transferred to turpentine, which expels the alcohol and leaves the whole transparent.

are visible on each side of the fourth ventricle, and two pyramidal tracts are continued from them as far as the posterior bulging of the chord, dilating in this last as well as in the brachial enlargement; in comparing the posterior pyramids with the other bulgings of the pyramidal tracts, I am led to the conclusion that they are repetitions of similar parts, and that each tract enlarges in the medulla oblongata, just as it enlarges in the brachial or crural bulging.

The fourth ventricle results from the separation, or perhaps more correctly from the want of union, of the lateral portions of the chord on the back. By a comparison of the adjoining Figs. 1 and 3, it will be seen that the section of the chord and that of the medulla are reducible to the same typical structure. In Fig. 3 the white substance is still presented in the form of two crescents, *a*, but their concavities, instead of being turned towards each other, are directed upwards, and within them the gray substance, *b*, is spread out, and is covered by an epithelium layer, *c*. This last is continuous with, and is an expansion of, the layer of epithelium which lines the central canal of the chord, and the gray substance is likewise continuous with that of the chord, but is fissured as far as the central canal.

Fig. 3.



Opposite the origins of the vagus and trigeminus nerves, there are slight ganglionic projections into the cavity of the ventricle; but they are very indistinct, and can only be seen after close examination.

As has already been stated, the fourth ventricle is closed over by a membranous covering, which in its minute structure is reducible to a vascular plexus, like that of the pineal body, or like the plexus choroides of higher animals; the vessels form a series of loops connected with a central vessel, and projecting to the right and left; it is covered with ciliated epithelium. The existence of vibrating cilia on the ventricular side, and of a fluid in the cavity of the ventricle, involves the necessity of the fluid being kept in constant motion. From what has been before stated with regard to vibrating cilia in the cavity of the ventricles of the brain and on the pituitary body, it is rendered highly probable that a circulation of serum exists through the cavities of the ventricles, passing through the passage from the third to the fourth ventricle. If vibrating cilia should hereafter be detected in the central canal of the spinal chord, this last would also be the seat of a similar movement.

The change of form which the spinal chord undergoes during the progress of development is one of its most interesting features, and one which long since attracted attention. The phases are the same that are met with in other Vertebrates in which limbs are developed; but while in these the changes take place with great rapidity, in Frogs generally the ichthyic condition of the chord in which there are no enlargements or bulgings continues for several months, the eggs being hatched in the spring and the complete development taking place in the latter part of the summer. In Bull-frogs, in this latitude at least (42° North), development lasts not less than a year, as the tadpoles hatched in the spring pass the following

winter in the same condition, the metamorphosis occurring during the following spring or summer.

Until the legs begin to be developed, the chord presents the form of an extremely elongated cone, and the bulgings, as was noticed by Serres, are developed simultaneously with the legs. I have not, however, been able to confirm the statement made by him, and repeated by others, that the caudal portion of the chord is shortened as the legs and the bulgings are developed. According to my observations, no shortening takes place until the absorption of the tail commences, and this happens after the bulgings are formed and the legs have acquired their growth. The whole of the caudal prolongation, however, is not absorbed, a portion being persistent, and eventually becoming enveloped by the elongated coccyx.

The caudal portion of the chord in the tadpole is so much reduced in size, that it affords an unusually good opportunity for microscopic examination. It is much flattened, has no fissures, is of an opaque white on the sides, but in the centre a transparent band is visible through its whole length. Examined with a power of one hundred diameters, or even less (Plate I. Figs. 16, 17), it is easily resolved into nerve tubes and cells, the first forming the opaque lateral bands, and the latter a transparent central stripe. The cells are like those described as existing in the brain, spheroidal, filled with granules, the walls attenuated and easily ruptured. None of them are caudate, and no direct connection was noticed between nerve tubes and cells, the former being almost wholly longitudinal, running with great regularity parallel to each other, and giving off nerves to the lateral muscles which form so large a portion of the tail. As the eye traverses the chord from the apex towards the brain, there will be seen, as we approach the former, here and there a nerve tube running more or less obliquely across from one side to the other; a little farther forwards the tubes become more numerous, until at length they are found very abundant in the posterior part of the trunk. Over the transparent central portion of the chord there may be seen, with a very high power, very minute longitudinal fibres (Plate I. Figs. 15, 16), which appear to be solid, and have not the double outline found in nerve tubes caused by the substance of Schwann.

From the description just given, it will be seen that the chord gradually becomes more simple in the caudal portion, that transverse fibres gradually become less numerous, and are eventually omitted, and that the nerve tubes and cells, as elsewhere, have no direct connection. The lateral strands of nerve tubes appear to be continuous with the white columns of the chord proper, and if they anywhere intermix with the nerve cells, it must be in some other place than in the caudal portion.

In one particular, then, the caudal prolongation of the chord in the tadpole differs in structure from that of the true chord, in having the nerve roots all ascending towards the dorsal region of the chord, and none of them passing among the cells of the central portion opposite to the points at which they are attached.

Section IV. — Peripheral Portion of the Nervous System.

The peripheral system, composed of the different nervous trunks, which it is here proposed to describe somewhat in detail, is in Frogs comparatively simple; far more so than in any Mammals, Birds, or higher Reptiles, and more so even than in most Fishes. This simplicity results in part from the reduction in number both of cranial and spinal pairs of nerves; in the former it seems as if by suppression of some of them, but in reality it is by the union of two or more pairs which in other animals form so many separate nerves. Another condition in which its simplicity is also manifest is in the absence of those extensive anastomoses and plexuses, which render the whole system of the animals in which they exist so intricate. In consequence of these peculiarities, the nervous system of these animals becomes a matter very interesting to the physiologist and anatomist, enabling him to study the whole in a form almost typical, perhaps as much so as a natural form ever is, and at the same time throwing some rays of light on the subject of philosophical anatomy.

The number of pairs of nerves connected with the central axis and escaping through the walls of the cranium or the vertebral column, does not exceed in all seventeen, of which seven are given off either by the cerebral masses or the medulla oblongata,* and ten from the spinal chord. If we compare the number of pairs of spinal nerves, as indicated by the number of vertebræ in the different species of Vertebrates noticed in the tables of Cuvier, it will be found that in none, a few Batrachians alone excepted, is it reduced so low as in Frogs. According to Cuvier the following species present the smallest number of vertebræ in the classes to which they respectively belong.

Gibbon (Mammal),	31	Vertebræ.
Hoopoe (Bird),	35	"
Chelys anatomata (Reptile),	38	"
Ostracion triangularis (Fish),	15	"
Frogs (Cuvier, 9 pairs),	10	"
Pipa (Surinam Toad),	8	"

With regard to the cranial nerves, there exist among Fishes even, as will be seen hereafter, only the genera *Amphioxus*, *Bdelostoma*, *Myxine*, and *Lepidosiren* in which the number is known to be actually less, the first having but three pairs, *Lepidosiren* five, and the others but six. *Petromyzon*, according to Muller, has nine pairs, and according to Panizza, eight. In the larger portion of the whole Vertebrate division, at least ten or twelve pairs may be made out, the accessory nerve being the one which is most frequently deficient. The following table exhibits an enumeration of the cranial nerves of Man and Mammals contrasted with those of the Frog, showing at the same time what pairs are united in the latter, so as to reduce the whole number from twelve to seven pairs.

* "In the brain of the Frog only eight separate pairs are found, the facial, glosso-pharyngeal, accessory of Willis, and hypoglossal exhibiting no distinct roots"; "the hypoglossal is given off by the first pair of cervical nerves." Wagner, *op. cit.*, p. 151. This statement, as will be seen, is not strictly applicable to the present species.

A. Cranial Nerves: —

Mammals.	Frog.
I. Olfactory	I. Olfactory.
II. Optic	II. Optic.
III. Motor communis	III. Motor communis.
IV. Patheticus	IV. Patheticus.
V. Trigeminus, VI. Abducens, VII. Facial — are combined and form	V. Trigeminus.
VIII. Auditory	VI. Auditory.
IX. Glosso-pharyngeal, X. Vagus, XI. Accessory — are combined and form	VII. Vagus.
XII. Hypoglossal.	

B. Spinal Nerves of the Frog.

I.	Hypoglossal.
II., III.	Brachial.
IV., V., VI.	Abdominal.
VII., VIII., IX.	Crural.
X.	Coccygeal.

From this table it will be seen that the hypoglossal nerve in the Frog occupies a position somewhat anomalous, forming as it does the first pair of the spinal series. If this were added to the cranial nerves, to which it belongs in nearly all other Vertebrates, the whole number would be eight; namely, three special sense nerves, and two pairs (viz. the motor communis and patheticus) endowed with common motor properties, and three (viz. the trigeminus, vagus, and hypoglossus) having both motor and sensitive filaments combined. To these last Sir Charles Bell applies the term "spinal," and Muller that of "cranio-vertebral." A larger number of cranial nerves has been described by some anatomists in closely allied Batrachians, but after repeated dissections, as will be seen in the sequel, there seems satisfactory reason, as regards the species here under consideration, for adhering to the enumeration given above.

I. *Olfactory Nerves.* (Plate I. Fig. 1, i. and Plate II. Fig. 11, B.) — These arise from the anterior and under portion of the olfactory lobes, their union with which can only be seen distinctly after the membranes have been wholly removed. On the anterior extremity of the lobe they form a kind of cap, but beneath extend in the form of a narrow band, situated near the outer edge, as far as the union of the olfactory with the cerebral lobes, where they terminate in a rounded bulb. From this band extending beneath the lobe, there is given off at its commencement another series of fibres, which are directed inwards, separating from each other and forming a brush. The trunk of the nerve is about two or three lines in length, is directed forwards, and each nerve escapes through a separate opening in the anomalous bone, described by Cuvier as the "*os en ceinture*," and regarded

by him as the representative of the united frontals of serpents, and by others as the ethmoid. The nerve trunks, after passing these openings, divide into two branches, each of which breaks up into a brush of filaments, and are distributed to the upper and under surfaces of the olfactory pouches, but principally to the former.

The minute structure of this nerve, as in other animals, is quite different from that of the other sense nerves. Its fibres have not the appearance of being tubular, are not varicose, and are flattened and closely matted together, resembling the fibres of the nerves of organic life.

II. *Optic Nerves.* (Plate I. Figs. 1 and 3, II.) — These, when stripped of their thick sheath exteriorly to the cranium, or when examined within the cranial cavity, are a little less voluminous than the preceding pair, though the organ of sense with which they are connected is larger and more complex. Behind the decussation, each nerve, as it advances towards its ganglionic centre, divides into two distinct fasciculi of fibres; the anterior fasciculus is directed upwards, its fibres being distributed to the anterior portion of the optic lobe, and in part to the adjoining portion of the optic thalamus, while the posterior, passing beneath the lobe, enters it upon its posterior face. If the brain have been previously macerated in strong alcohol, this demonstration is rendered still more clear by cutting through the optic nerves at the decussation, and on tracing up each nerve towards its origin, it will be found that the only direction in which the fibres may be separated without rupture is towards the ganglionic masses above mentioned. The connection of these nerves both with the optic lobes and optic thalami seems unequivocal, and is a fact of interest bearing on the connection of both these organs with the sense of vision, and this view is supported by the evidence derived from pathology and experiment. Many observers have shown, by dissection, that blindness of long standing is followed by atrophy of the optic lobes (agreeably to the well-known law of atrophy following disuse), and that extensive lesions of the lobes are attended by either impairment or loss of vision. In recent dissections of Frogs, similar results have been observed. One in which the *right* eye had been destroyed had atrophy of the left lobe, which was reduced by nearly one third of the dimensions of that of the opposite side. The condition of the nerve was not examined. In a second instance, there was blindness from destruction of the *left* eye, in which there was atrophy of the left nerve before the decussation, of the right nerve behind the decussation, and of the right optic lobe.* In neither of these cases was there any marked alteration in the proportions of the optic thalami.

The facts furnished by comparative anatomy, however, tend to show that vision is not the sole function of the optic lobes. There are well-known instances of animals, whose lives are passed either in caverns or localities from which the light is excluded; one of the most remarkable of these animals is the Blind Fish (*Amblyopsis spelæus*, Dekay) from the Mammoth Cave of Kentucky. In these no

* American Journal of Medical Sciences, edited by Isaac Hayes, M. D., for October, 1852.

eyes are developed,* and yet the optic lobes do not remain undeveloped to a corresponding degree, but, on the contrary, acquire a proportional size nearly equal to that of other Fishes with normal vision. While, on the one hand, there is sufficient evidence to show that the optic lobes are connected with vision, there is, on the other, evidence to prove that they exist without vision, or entirely out of proportion to the visual organ, as in *Proteus*.

The instances of *Proteus* and *Amblyopsis* naturally suggest the questions, whether one and the same part may not combine functions wholly different in different animals, and whether the same may not hold true with regard to the cerebral organs which is known to obtain with regard to the skeleton, the teeth, the tongue, and the nose, that identical or homologous parts in different animals may perform functions wholly distinct. If the doctrine here suggested can be admitted (and if this were the place facts could be cited in support of it), may we not find in it an explanation of many inconsistencies which now exist between the results of comparative anatomy and physiology?

III. *Motor Communis (oculo-motor)*. (Plate I. Fig. 1, III.) — In the whole Vertebrate series of animals, there is generally but little variety in this nerve; but the exceptional cases have given rise to some difference of opinion as to its true nature, and as to its relationship to the trigeminus. The ordinary distribution of this nerve is as in the human body. On entering the orbit, it divides into two principal branches; a superior, which is distributed to the upper rectus and levator of the upper eyelid, and an inferior, distributed to the rectus internus, and the rectus and obliquus inferior. In Batrachians the distribution is exceptional, and is differently described. Cuvier leaves us to infer that it is the same as in Man. Stannius describes it as dividing into two branches, "and which are distributed to the rectus superior and inferior, and obliquus inferior; at the same time, in Salamanders and Tritons, the rectus superior receives its filaments from the ophthalmic nerve" (ophthalmic branch of the trigeminus).

As seen in my dissections the motor communis arises as a minute filament from the under surface of the medulla oblongata near the median line at its anterior part and just behind the pituitary body; it is then directed outwards and forwards, perforates a little obliquely the cartilaginous sides of the cranium, just in front of the trigeminus; on reaching the orbit, it crosses the ophthalmic nerve in close contact, and has the appearance of becoming incorporated with it, which has led to an erroneous description on the part of some anatomists. The nerves, however, simply cross, there being no intermixture of filaments whatever. The branches given off by the motor communis are, 1st. a branch passing along the border of the rectus internus to the inferior oblique; 2d. a branch to the rectus internus; 3d. to the rectus inferior; and, 4th. to the rectus superior. (Plate II. Figs. 4, 5, 6.)

* Johannes Muller thinks that an eye actually exists; but according to his description, it is "an extremely small black point, without a cornea, of which the pigment forms the external layer, and under which lies a colorless membrane; nothing was determined on with certainty with regard to the contents"; no optic nerves were traced. — Memoir on the Blind Fishes and some other Animals living in the Mammoth Cave, Ky. By Theodore A. Telkampf, M. D. New York Journ. Med., July, 1845.

IV. *Patheticus.* (Plate I. Figs. 2 and 6, IV.) — This is certainly an independent nerve, and at its origin conforms with the general description of the same nerve in other animals. It arises behind the optic lobes, from the part corresponding in position with the valve of Vieussens; it perforates very obliquely the cartilaginous lateral wall of the cranium, in front of the motor communis; it runs parallel to and in company with the ophthalmic nerve, and with a small branch of this last seems to form an anastomosis (Plate II. Figs. 4, 5), and is described as forming one by several writers; it gives no branches, however, until it reaches the obliquus superior muscle, in which it is wholly lost.

Stannius describes this nerve as "distinct in the Anourous Batrachians, and as distributed to the superior oblique; but in Tritons and Salamanders it appears to be entirely incorporated with the trigeminus, so that it is the ophthalmic branch which furnishes filaments to this muscle." * Cuvier doubts the existence of any communication between this and the ophthalmic nerve, and regards the supposed anastomosis as merely an apposition, "*qu'il ne qu'accole à ce nerf.*" † Vogt has seen a filament of this nerve anastomose with the ganglion of the trigeminus in *Bufo pantherius.* Fischer could not detect the existence of the patheticus in *Salamandra terrestris*, and therefore infers that it is derived from the ophthalmic branch of the fifth, since this last supplies the superior oblique with its motor filaments.

After repeated dissections, I am satisfied that the description of Cuvier is correct as far as it relates to *Rana pipiens*, and that, however close the contact be between the patheticus and the branch of the ophthalmic, no anastomosis really occurs; and am led, therefore, to the conclusion, that the patheticus, which in Tritons and Salamanders is a branch of the trigeminus, is in Frogs a separate and independent nerve.

V. *Trigeminus.* (Plate I. Fig. 1, V.; Plate II. Fig. 2, V.) — This has always attracted the attention of anatomists and physiologists, on account of its extended distribution, its connection with other nerves, and its relations to the organs of sense; also on account of its great resemblance, in the existence of a ganglion, to a common spinal nerve. In Frogs it becomes especially interesting, since, in addition to the three principal trunks found in other animals (namely, the ophthalmic, superior maxillary, and mandibular), it includes the *facial* as well as one of the motor nerves of the eye, namely, the abducens. The different roots which are united in the trigeminus are widely separated from each other, and, as here described, include all the roots arising from the medulla oblongata, and which become connected with the trigeminal ganglion. The *principal* one, and which corresponds with the trigeminus proper, arises from the most convex part of the lateral portion of the medulla oblongata, by several distinct fasciculi, which unite and form a single trunk, that is directed obliquely forwards and enters the ganglion; this trunk includes both motor and sensitive filaments. The *second* is the facial (Plate I. Fig. 1, *a*), which emerges from the medulla in close contact with the auditory nerve, and, after accompanying it for a short distance, is directed obliquely

* Siebold et Stannius, Nouveau Manuel d'Anatomie Comparée, Tom. II. p. 203.

† Leçons, Tom. III. p. 188.

forwards, and joins the principal root of the trigeminus, into the ganglion of which it enters. The *third* (*b*) root is equally peculiar, and is longer and far more slender than either of the others; it is so delicate, that, unless great caution be used, it will be torn away in the removal of the membranes. The facility with which it is destroyed offers a probable explanation of the fact, that it has so frequently escaped observation. Its origin is about midway of the medulla on its lower face, and quite near to the median line; this also joins the principal root, and becomes involved in the Gasserian ganglion. The origin of the last-described root corresponds with that of the *abducens*, of which there can be no doubt that it is the homologue, as shown by Vogt.*

We have here, then, one interesting feature of the trigeminus; namely, that all the roots, whether motor or sensitive, pass through the ganglion, a condition not usually found in the same nerve in other animals. All the roots thus united and connected with the ganglion escape from the cranial cavity through *one* and *the same* foramen in the (wing of the?) sphenoid. The ganglion is usually quite near to this foramen, may even occupy it, or be exterior to it. The Gasserian ganglion in its shape somewhat resembles the same part in the human body, but has the characteristic yellow color of that of the vagus and spinal nerves. From its convex surface, three large trunks and one smaller one are given off.

A. *Ophthalmic or Orbitar Branch.* (Plate II. Figs. 2, 3, *a*.) — After leaving the ganglion of Gasser this nerve is directed forwards parallel to the sides of the cranium, till it reaches the co-ossified frontals or the "*os en ceinture*"; this it perforates, gains its cavity, and is again directed forwards, and divides into two branches; one of these, the superior, crosses the olfactory pouch and branches of the olfactory nerve above, and, inclining towards the median line, is distributed to the skin on the lips over the intermaxillary region; the other, passing externally to the olfactory pouch, is lost in the skin behind the preceding. The upper branch, crossing the olfactory nerve at an acute angle, gives as it passes small branches to the pouch itself. (Plate II. Fig. 11.)

Of the collateral branches of this nerve, the first is quite small, and may be traced as far as the sclerotic, which it perforates near the optic nerve, while other filaments enter it nearer to the cornea, and these may therefore be regarded as *short* and *long ciliary nerves*. The next, which is the longest of the collateral branches, from its distribution might be denominated *palatine* (Plate II. Fig. 2, *b*), though not the homologue of the same nerve in man, since this last is derived from the sphenomaxillary ganglion, which is a dependence of the maxillary branch of the trigeminus. The palatine nerve in Frogs is quite easily detected on raising the mucous membrane of the roof of the mouth, to which it gives numerous filaments, and is directed parallel and runs quite near to the median line, lying just beneath the base of

* "The abducens takes its origin from the anterior end of the medulla oblongata near the median line, runs obliquely forwards towards the cavitas occuli under the fifth nerve, passes near the ganglion Gasseri, sending a branch to it, while the greater part passes beyond this ganglion and is lost in the muscles." C. Vogt, *Beiträge zur Nevrologie der Reptilien*. Neuchatel, 1840. See Fischer, *Amphibiorum Nudorum Neurologiæ Specimen*, p. 5.

the skull. A little in front of the globe of the eye it divides into two branches, one of which extends forwards as far as the vomerine bones (*c*), where it gives filaments to the internal nasal orifice, and to the neighborhood of the vomerine teeth; while the other, the larger, bends directly outwards (*d*), is situated behind the palatine bones, till it reaches the inner surface of the upper jaw, where it forms a distinct union with the superior maxillary nerve, and after the union of the two their terminal branches are distributed to the neighboring mucous surfaces. The other collateral branches of the ophthalmic nerve are quite minute, one of which is given to the upper eyelid and the skin in front of it, and two others perforate the united frontals, and are distributed to the skin over the nasal cavities, and to that of the nasal orifices.

B. *Upper Maxillary Branch.* (Plate II. Figs. 2 and 3, *e.*) — This and the lower maxillary branch are so closely connected at their origin from the ganglion, that for a short distance they appear to form but a single trunk, though with a little care they may be completely separated. They become disjoined just behind the globe of the eye, where the upper jaw branch gives off some minute filaments, which pass between the muscles of the lower jaw, and are distributed to the sensitive surface of the eye. A small branch is also given to the choanoid muscle, and it is near this point that the *abducens* leaves the trigeminus to reach the external rectus muscle. The terminal filaments, which may be regarded as identical with the infra-orbitar nerve of the human body, are lost in the skin beneath and in front of the globe of the eye. A collateral branch extends inwards beneath the eye, and meets with the palatine, as already described, at *d*.

C. *Mandibular or Lower Jaw Branch.* (Plate II. Figs. 2 and 3, *f.*) — The third principal trunk corresponds in its distribution with the same nerve in the higher animals. Near its origin branches are given to the muscles of the lower jaw, but on reaching the angle of the jaw it passes over it to the outside; then, descending beneath, it runs parallel to it as far as the symphysis, where it breaks up into a brush. Its collateral branches are distributed to the skin of the lower jaw and to the mylo-hyoid muscle.

D. *Facialis* (*Portio dura*). (Plate I. Fig. 1, *a.*) — The nerve in Frogs to which this name has been given is quite different, in its mode of origin and of distribution, from that to which the name has been given in the higher animals. The descriptions of it by anatomists are far from coinciding with each other, and will be found somewhat at variance with that which follows.

In describing this nerve, Cuvier does not appear to speak from personal observation when he says, that "it is believed that a branch of the eighth pair (vagus) in tailless Batrachians, as it goes towards the trigeminus, meets with a branch escaping from the semilunar ganglion, and that the two united form the facial." * Wagner, in speaking of the cranial nerves in Frogs, says that the facial exhibits no distinct roots, and is supplied as a branch of the acoustic.† Muller, referring to Volkman, remarks: "In Frogs Volkman has described a nerve analogous to the facial, which

* Leçons d'Anat. Comp., 2me edit., Tom. III. p. 219.

† Elem. Comp. Anat. Verteb. Animals, New York, 1845, p. 151.

enters the ganglion of the fifth pair, but immediately separates again from it, and is continued as the tympanic branch of the fifth, till it joins the laryngeal branch of the vagus. This laryngeal branch of the vagus is given off by the glosso-pharyngeal branch of the latter nerve, and its anastomosis with the facial may be compared to the similar connection of the glosso-pharyngeal with the facial in the human body."* Vogt, in his excellent memoir on the nervous system of Reptiles, describes this nerve in Toads, after leaving the ganglion, as "winding around the labyrinth to the cavitas tympani, behind which it meets with a branch of the glosso-pharyngeus; these two united nerves bend over the articulation of the lower jaw, and branch off to the skin and muscles, just as Volkman has described it."† Stannius describes the nerve somewhat more fully, as follows: "Another peculiarity of Fishes is found in this, that the facial nerve, which corresponds in a great measure with the opercular branch of this class, sends a lower maxillary nerve, which accompanies the alveolar branch of the trigeminus and anastomoses with it. In all Anourous Batrachians, this facial or jugular nerve receives an anastomosing filament from the first branch (analogous to the glosso-pharyngeal) of the vagus. Its first branch is ordinarily destined to the skin comprised between the membrane of the tympanum and the angle of the mouth (auricular branch); the second is the lower alveolar just mentioned, and the third is distributed in part to the sterno-hyoid, and in part to the skin of the thoracic region."‡ The following may be added to the quotation made above from Cuvier: "In tailless Batrachians, a portion of the facial seems to be furnished by the fifth pair under the form of a fourth branch escaping from the semilunar ganglion."§ This, however, he states on the authority of Fischer.

According to my dissections, the following appears to be a true description of the origin, connections, and ultimate distribution of the so-called facial nerve in the species of Frog here noticed. The manner in which it becomes connected with the Gasserian ganglion has already been noticed (p. 27). It is the smallest of the branches derived from the ganglion, which it leaves at its inferior angle, and is directed outwards, passing around the bony walls of the vestibule; it passes backwards over the columella, with which it is in close contact, and, while still beneath the tympanic bony circle, is joined by a branch from the glosso-pharyngeal of the vagus, or by a branch from a common trunk, which is divided into the glosso-pharyngeal and this anastomosing branch. (Plate I. Fig. 1, *c*; Plate II. Fig. 2, *g*.) The single trunk formed by the union of these two branches is directed downwards and backwards behind the tympanic cavity, to just above the angle of the jaw. After it has reached this point, it is far from easy to trace its terminal branches, but after many dissections, both with and without water acidulated with dilute nitric acid, the following distribution has been made out, and it goes to prove, that, although the nerve in question is doubtless the homologue of the facial in Man and Mammals,

* Physiol., Baly's Trans., Vol. I. p. 834.

† Vogt, Beiträge zur Nevrologie der Reptilien, p. 52.

‡ Siebold et Stannius, Man. d'Anat. Comp., Paris, 1850, Tom. II. p. 204.

§ Cuvier, Leçons, Tom. III. p. 207.

yet its distribution and properties are widely different. The branches from the common trunk resulting from the union of the nerve from the trigeminal ganglion and that from the vagus are three, liable, however, to slight variety, sometimes there being but two, and one of these giving off the third.

a. The first of these (Plate II. Fig. 2, *h*) is directed forwards and outwards, and passes over the tympanic and pterygoid bones just above the articulation of the lower jaw; it gives a small filament to the walls of the cavity of the tympanum, after passing which it divides into two terminal branches, one of which is distributed to the skin behind the angle of the jaw, and to the sides of the throat in the neighborhood of the cicatrices formed by the obliteration of the openings through which the fore legs are protruded when they first appear externally; the second is directed forwards, and is lost on the skin covering the angle and the posterior half of the lower jaw; near its termination this last branch forms an anastomosis with the external lower jaw branch of the trigeminus.

b. The second trunk of the facial (Plate II. Fig. 2, *i*) descends along the horns of the os hyoides, but in its passage no branches were detected until it reached the line of union between the mylo-hyoid muscle and the skin (which occurs on either side, midway between the median line and the branch of the lower jaw); there it passes to and is distributed in the skin covering the throat between the angles of the lower jaw under the larynx and in front of the sternum. No branches whatever were traced to any of the muscles among which it passed.

c. This is the larger of the three (Plate II. Fig. 2, *k*); it passes inside of the angle of the jaw, reaches the inner surface of this last, and follows the line of union between the mylo-hyoid and lower jaw as far forwards as the symphysis. In its course it gives filaments to the mucous membrane of the floor of the mouth, especially at the posterior part, corresponding with the position of the air-sacs of the male; the largest portion of its terminal filaments reach the mucous membrane at the union of this last with the jaw, and are all given off from the convex side of the nerve; all are therefore directed outwards. This branch, however, is not in close company with the lower jaw branch of the fifth, as stated by Stannius, though they run a parallel course.

According to the description just given of the nerves derived from the trunk formed by the union of branches from the trigeminal ganglion and the vagus, it must, reasoning from analogy, be endowed mainly, if not wholly, with *sensitive* properties. No filaments were traced to muscles, though it is not impossible that some minute muscular filaments may have escaped notice; if any do exist, they were too small to be seen with a lens magnifying three diameters, after the preparation had been immersed in dilute nitric acid. The correctness of this investigation by anatomy is confirmed by the evidence derived from galvanism, for the application of this agent when the nerve was fairly insulated produced no muscular contractions; and we might add in evidence the negative fact, that the muscles of mastication and those of the hyoid apparatus are respectively supplied from the lower jaw branch of the trigeminus and the hypoglossus nerves. From what has been said, then, it follows that the so-called facial, even if we admit the existence of motor

properties, is quite different from the same nerve in the human body; in Man it is almost wholly motor, having no sensitive filaments, except such as are derived from anastomosis, and which are intended to give a muscle its ordinary sensibility; thus its distribution is entirely muscular. In Frogs, on the contrary, as far as observed, its distribution is wholly cutaneous, its fibres having been traced to the skin about the tympanum, the angles of the mouth, the submaxillary and lateral jugular region.

The description given above, when compared with those of others which precede it, corresponds with that of Cuvier and of Vogt as to the origin of its vagal and trigeminal branches. Cuvier says nothing of its ultimate distribution, other than would lead to the inference that it has the ordinary distribution of the facialis. Vogt's statement, likewise that of Volkman, that it is distributed to the muscles of the lower jaw, I have not been able to verify. There does not appear any reason from analogy, or from the dissections just described, why Volkman should apply the term laryngeal to the anastomosing branch from the vagus. An anastomosis exists between the facial and glosso-pharyngeal nerves in the human body, but no branch termed laryngeal is given off from them, nor is the nerve in question entitled to that name from its distribution. The only true laryngeal nerve in Frogs, as will be seen, is given off, not by the nerve just referred to, but by the third or visceral trunk of the vagus, and is the homologue of the recurrent in Man. The description given by Stannius is certainly the most complete, and he is almost the only one who seems to have traced the branches to the skin.

The anatomy of the facialis in *Salmo fario*, as given by Agassiz after his original dissections, shows the existence in this Fish of a condition similar to that of Frogs. "The facial nerve escapes from the brain by the lateral furrow of the medulla oblongata; it is intimately connected with the root of the acoustic, and is separated from the trigeminus, but instead of following the course of the acoustic, its fibres pass obliquely towards the ganglion of Gasser, and, uniting to its inferior face, to the fibres of the trigeminus, and especially to the suborbitar branch of that nerve. Although there is evidently a mixture of these two nerves, we can nevertheless follow a great part of the fibres of the facial, which pass directly to the inferior face of the ganglion, into a single nerve which escapes from the cranium through the hole in the great wing of the sphenoid in company with the trigeminus." * While the ultimate distribution is different in the two, yet Frogs and Trouts have this in common, that the facial becomes an appendage of the ganglion of Gasser, and as in other Fishes it becomes more or less blended with the trigeminus. As it is in no instance bodily combined with any other nerve, we may safely conclude that, philosophically considered, the facial in Man is a dismemberment of the trigeminus.

VI. *Auditory.* (Plate I. Fig. 1, VI.) — This nerve likewise arises from the lateral portion of the medulla oblongata in two portions closely approximated to each other. They enter the vestibule, sometimes still united by a single foramen, at others slightly separated, and then by two foramina. I have noticed one of these conditions on the right and the other on the left of the same individual. After entering the vestibule, the two roots separate from each other, and are distributed

* Agassiz and Vogt, Anat. des Salmonés, p. 168; also Table M, Fig. XVI.

to the mass of calcareous crystals occupying the vestibular cavity, and to the semicircular canals.

VII. *Vagus.* (Plate I. Fig. 1, VII.; Plate II. Fig. 2, VII.) — This is the last of the pairs of nerves escaping through the cranial walls; it arises from the dorsal surface of the medulla oblongata a little behind its lateral portion, by three or four slightly separated roots. The most posterior of these is attached somewhat farther towards the median line on the motor or lower surface than the others, and may therefore be compared to a motor root of a common spinal nerve; if this be identical with any separate nerve in the higher animals, it is with the accessory of Willis, though it has not that peculiar origin, by numerous roots extended for some distance along the medulla, as in higher Reptiles; for example, in the Tortoise.* Reasons for believing in this identity will be found in the description of the ultimate distribution of the nerve. The trunk of the vagus makes its exit from the cranial cavity through a hole in front of the occipital condyles, which, when examining the cranium alone, might from its position be mistaken for the anterior condyloid foramen. Immediately after leaving the cranial cavity it becomes involved in its ganglion, the largest of the whole series of ganglia connected with the cranio-vertebral series of nerves. All the root fibres probably pass through the ganglion. A filament of the sympathetic nerve unites the vagal and hypoglossal nerves with each other, and between the two is a ganglion, the first of the sympathetic series. The vagal trunks are three in number.

A. The first and smallest of the three is given off from the upper portion of the ganglion (Plate I. Fig. 1 and Plate II. Fig. 2, *b*), is directed upwards till it reaches the skin just above the tympanum, as described by Volkman, and is ultimately distributed to the integuments between the tympanic membranes and the eyes, and on the scapular region from above downwards as far as the level of the lower edge of the tympanum. This nerve is supposed by Muller to be the remnant of the nervus lateralis of the tadpoles, a view which does not seem to be confirmed, since they have the nervus lateralis in addition, and the nerve in question is not a branch of the lateralis, but is derived directly from the ganglion. A more probable supposition is to regard it as representing the dorsal branch of a common spinal nerve, a branch which is repeated for every pair of nerves along the back; and here we have additional evidence in favor of the identity of the cranial and vertebral series of nerves.

B. (Plate I. Fig. 1, *g*.) This trunk, after passing outwards one or two lines, divides into two branches, one of which is directed forwards, and, curving around the posterior surface of the vestibule, joins the branch from the trigeminus, with which it forms the so-called facial nerve. The second branch is directed a little backwards, descends along the sides of the neck, where a minute filament is given to the mucous membrane of the œsophagus, passes over the body of the hyoid bone, giving filaments to the mucous membrane of the floor of the mouth, then along the upper surface of the genio-hyoid muscle on the median line till it reaches the symphysis of the lower jaw, where it enters the base of the tongue and is distributed to the mucous membrane alone. When the tongue is retracted, this nerve is thrown into

* See the figures of Bojanus in his Anatome Test. Europ., Plate XXI. Figs. 87 – 92.

numerous zigzag folds, which adapt it to the peculiar extensibility of that organ. This nerve was not traced to any of the muscles among which it passed, nor were any contractions of the hyoid and glossal muscles produced when the nerve was excited by galvanism, proper care being taken to secure its complete insulation.

The distribution of this nerve to the mucous membrane of the tongue pharynx indicates that it is a nerve of sensation, and its connection with the vagus shows that it can be no other than the *glosso-pharyngeal*, which in the higher animals becomes disjoined and forms an independent pair.

Muller says: "The glosso-pharyngeal of the vagus (in Frogs) is the only branch analogous to the glosso-pharyngeal in the human body, and this he regards as supplying the place of the gustatory branch of the fifth." This distribution has an analogical interest, since if it be the seat of the sense of taste (and it is the only sensitive nerve going to the tongue) in these animals, it tends to show that the glosso-pharyngeus in Man, about the function of which so much controversy has existed, may be a gustatory nerve. "The glosso-pharyngeus and vagus are separate at their roots, but unite immediately in the skull into one nerve which swells into a large ganglion outside of the skull. Before the glosso-pharyngeus enters the vagus, it sends off a minute branch, which runs forwards in the pia mater under the acousticus over the cerebral portion of the sympatheticus, and penetrates the ganglion Gasseri. According to Volkman's description it does not exist in *Rana*, neither could I convince myself with certainty of its existence in *Bufo cinereus*, for the large collection in the membranes of the brain of masses consisting of microscopical crystals, prevents to a great extent the preparation of so fine a filament. In *Bufo pantherinus*, however, I have it before me so completely prepared, that no doubt can remain of its existence and its course as described above. The glosso-pharyngeus leaves the ganglion of the vagus nearly as large a nerve as the vagus itself, gives the uniting branch to the facialis (which Volkman calls the laryngeal branch of the vagus), then runs downwards, sends a branch to the region of the glottis, and branches in the tongue as far as the tip. The real vagus runs exactly the course described by Volkman, along the œsophagus, with branches to the immediate muscles, and gives off the recurrent and the branches to the skin." *

C. This is the largest of the vagal branches, and corresponds with the *vagus* of the higher animals (Plate II. Fig. 2, *l*), in them the glosso-pharyngeal being a separate nerve; it descends along the sides of the neck, having the glosso-pharyngeal in front and the hypoglossal behind, the latter crossing its course over the stylo-hyoid muscle. The first branch which is given off by it is a minute twig to the stylo-hyoid muscle at its upper part, and may be distinctly traced by the naked eye among its fibres as far as the middle. A little below this a much larger branch leaves, but runs parallel to its course for a short distance, but soon passes in front of the pulmonary artery, then beneath, and ascends a short distance behind it, and is distributed to the muscles of the larynx.† This, therefore,

* Vogt, *op. cit.*

† Weber has shown that even in the Frog a branch of the vagus gives off a filament which takes a retrograde course to the larynx. Muller's Physiol., Baly's Trans., 2d edit., Vol. I. p. 838.

must be regarded as the homologue of the "inferior laryngeal" or "recurrent" nerve of the human anatomist. That this homology is correct is still further indicated by the influence of galvanism, which, when applied high up on the sides of the neck, causes contraction of the laryngeal muscles. No superior laryngeal was detected. A little lower down than the origin of the recurrent branch, the whole trunk divides into two fasciculi of nervous fibres, one of which forms the œsophageal plexus, and the other is readily traced to the heart and lungs.

From the preceding description, it appears that the vagus arises from the lateral portion of the medulla oblongata, the only distinction between its root fibres being the slight separation of the anterior ones from the rest, which arise nearer the median line on the motor side of the chord. All its fibres appear to enter the ganglion; its branches are, — 1. to the skin behind the tympanum and over the scapula; 2. an anastomosing branch to one from the trigeminus forming the "facial"; 3. the glosso-pharyngeal; 4. the splanchnic portion, distributed to the heart, lungs, œsophagus, and stomach. Of the terminal filaments of its different trunks, some are distributed to the skin, others to mucous membranes, as to the œsophagus, tongue, and probably to the respiratory passages; there are also motor filaments to the stylo-hyoid, to the larynx, and to the spinal muscles immediately above its ganglion; these muscles it causes to contract when stimulated by galvanism.

The vagus nerve has been quite differently described by different anatomists, and it is only required that their descriptions should be placed side by side to render evident their occasional inconsistency. Cuvier, whose accuracy is generally so admirable, in describing this nerve seems to speak from analogy rather than personal observation. He speaks of its "accessory branch" as if it were a distinct trunk, when he says, "The accessory is found in all orders of Reptiles, and is arranged as in Birds." * He further states, "From the ganglion of the vagus in Frogs is given off a nerve for the muscles of the jaws, and another for the tongue"; the latter has just been shown to exist, but I have never traced any branches to the muscles of the jaws, nor have these muscles contracted when the vagus has been stimulated by galvanism. Opposed to this statement is the fact that the trigeminal branches are distributed to the muscles of mastication, and that they contract when the trigeminus is galvanized.

Wagner, in speaking of the vagus, says: "Some very delicate nervous radicles, arising from the inferior tracts of the medulla oblongata near to its *anterior* fissure, unite with it and appear to correspond with the glosso-pharyngeal." † This glosso-pharyngeal is one of the principal trunks from the ganglion, and cannot be identified with either of the bundles of roots; it has been shown to be a sensitive and not a motor nerve, as it would be were Wagner's description correct, which makes it arise near the anterior fissure.

Longet states, that "in Frogs there is given off from the ganglion of the vagus a branch which is distributed to the muscles of the jaws." ‡ This is a repetition of the statement of Cuvier.

* Leçons d'Anat. Comp., Tom. III. p. 226.

† Comp. Anat. of Verteb. Animals, p. 151, Am. ed.

‡ Syst. Nerveuse, Tom. II. p. 371.

Vogt describes the glosso-pharyngeal as giving a branch to the facial, "after which it runs downwards, sends a branch to the region of the glottis, and branches to the tongue as far as the tip"; the branch to the glottis I have not seen; and as he describes in addition a "recurrent branch," he evidently does not refer to this last.

Wagner leaves us to infer that he finds a part of the accessory nerve of the vagus, when he says, "Some of the roots of the accessory nerve appear to be absent."

Muller, quoting Weber, says: "In Frogs a branch from the ganglion of the vagus goes to the muscles of the lower jaw. It is the jugular branch of Volkman, who has shown its motor influence to be derived from a branch of the facial nerve which has coalesced with it. It is distributed partly to the hyoid muscles and partly to the muscles of the lower jaw." * I have seen no other nerve to which this description is applicable, than that formed by the union of a branch from the vagus and the trigeminus; the latter branch, arising from the side of the acoustic nerve, joins the ganglion of the trigeminus, and afterward the branch from the vagus. According to my dissections, none of its branches are muscular; although they pass among the muscles of the jaw, they were not traced to them, nor do they cause them to contract when galvanized; a small filament is given off behind the tympanum, which I at first thought was distributed to the masseter, but afterwards felt satisfied that I could trace it wholly to the membranous walls of the tympanic cavity. Volkman's statement, that it is distributed partly to the hyoid muscles, is also rendered improbable by the positive demonstration that these muscles get their nervous filaments from the hypoglossus.

Nervus Lateralis. (Plate II. Fig. 9.) — There exists in Fishes, as has long been familiarly known to comparative anatomists, a peculiar nerve, usually a branch of the vagus, though it may sometimes be the result of the union of branches from the vagus and trigeminus; or it may be derived from the trigeminus alone, which, from extending along the side of the body beneath the lateral line, has received the name of lateral nerve. "In *Salmo*, *Clupea*, and *Acipenser* it is formed exclusively by the vagus, but in many Fishes, as *Belone*, *Cottus*, *Cyprinus*, it is formed by a branch of the vagus which receives branches from the trigeminus." † In addition to this, there exists a nerve, first described by Weber, called the dorsal nerve, formed generally by a union of filaments from the fifth and vagus, which, escaping by an especial opening in the parietal and interparietal bones, extends along the whole length of the dorsal fin, receiving filaments from the intercostals, and giving nerves to the muscles of the fin rays. In *Silurus* it is derived from the fifth only, and in some others from the vagus.‡ The use of either of these nerves is unknown; Muller failed to produce muscular contractions by irritating with galvanism the lateral nerve of the carp. It is then in all probability simply a sensitive nerve.

* Physiol., Vol. I. p. 838.

† Owen, Lects. on Comp. Anat., Vol. II. p. 196.

‡ See Cuvier, Leçons d'Anat. Comp., Tom. III. p. 212.

It is an interesting feature in the anatomy of Batrachian Reptiles, which in so many respects resemble Fishes, that they should have, some of them temporarily and others permanently, a nerve which is strictly analogous to the nervus lateralis of Fishes. It has been found by Van Deen to exist in *Proteus*, by Meyer in *Menopoma*, and by Kuhn in Tritons, and probably it exists in all the other Urodels. Among the Anourous Batrachians it was first noticed in Frogs, by Van Deen.

Its distribution, as it was presented in the tadpoles of *R. pipiens*, is as follows. (Plate II. Fig. 9.) The vagus escapes through the cartilaginous occiput as a single trunk, and from its ganglion are given off the following branches: — 1st. A branch which unites with another from the trigeminus, and forms the facial. 2d. A cutaneous nerve, distributed to the skin of the neck and that of the branchial region. 3d and 4th. Two delicate filaments, which, one of them dividing, furnish three nerves (*d*), one to each of the branchial arches. 5th. The *nervus lateralis* (*c*); at its origin, this, like the preceding nerves, is concealed by the spinal muscles attached to the occiput; having extended outwards as far as the skin, it passes along the side of the abdomen just beneath the edge of the spinal muscles, and is continued along the side of the tail in the groove formed by the union of the upper and lower series of caudal muscular bands. Soon after leaving the vagal ganglion, the nervus lateralis gives off a delicate filament (*a*, *b*), which does not appear to have been noticed hitherto, and which is easily traced, if the parts have been macerated in dilute nitric acid; this branch ascends and is directed backwards till it reaches the base of the fold of skin forming the upper portion of the caudal fin, along the base of which it extends towards its termination.

While no doubt exists as to the identity of the nervus lateralis, there can be little that the branch just described is identical with the *nervus dorsalis* of Weber, it being, as in some Fishes, a branch of the vagus; in the case of Frogs it is wholly cutaneous, there being no muscles connected with the skin, and in Fishes it seems questionable whether this nerve is motor or sensitive. In Cuvier's Comparative Anatomy the following remark occurs in connection with the vagus, which it is of interest to mention here: "Up to the present time, no nerve analogous to the dorsal has been found in Reptiles. Nevertheless, the parietal bones of Saurians are pierced with a foramen like those of Fishes." *

The observation of the existence of a dorsal nerve gives additional importance to the discovery of the nervus lateralis by Van Deen; and if to these we add those branches of the vagus described above, which pass along the branchial arches, the analogy of the larvæ of Batrachians to Fishes becomes much more striking than there has been reason hitherto to regard it.

Section V. — Philosophical Anatomy of the Cranial Nerves and Skull.

In the table at the commencement of Section IV., the cranial nerves of Man and Mammals, and those of the Frog, are contrasted; it is there shown what nerves in the two correspond, and how it is that, by the union of two or more nerves, the

* Leçons d'Anat. Comp., Tom. III. p. 229.

twelve pairs in the one case are reduced to seven in the other. In the subjoined tabular view of the cranial nerves, as they are presented in some of the different members of the Vertebrate series, it is further seen that there exists a transition from the more simple condition, in *Amphioxus*, *Myxine*, and *Lepidosiren* among Fishes, and in Frogs among Reptiles, where the nerves are less numerous, to the most complex, in Mammals and Man; that the trigeminus and vagus, as we traverse the series, are, as it were, split up and dismembered, so as to make from the smaller number in the one case the larger in the other.

Table of the Number of Pairs of Cranial Nerves found in some of the Members of the Four Classes of Vertebrates.

	Olf.	Op.	M. c.	Path.	Trig.	Abd.	Fac.	Aud.	Gl. p.	Vagus	Access.	Hyp.	Total.
Man (Soemmering),	I.	II.	III.	IV.	V.	VI.	VII	VIII.	IX.	X.	XI.	XII.	12
Testudo Europæa (Bojanus),	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	12
Goose (Swan),	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	?	XII.	11
Boa (Swan),	I.	II.	III.	IV.	V.	?	VII.	VIII.	IX.	X.		XII.	10
Salmo (Agassiz),	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.		XII.	11
Raia (Swan),	I.	II.	III.	IV.	V.	VI.		VIII.	IX.	X.		XII.	10
Bufo palmarum (Fischer),	I.	II.	III.	IV.	V.	VI.		VIII		X.	XI.	XII.	10
Petromyzon (J. Muller),	I.	II.	III.	IV.	V.		VII	VIII.		X.		XII.	9
" (Panizza),	I.	II.	III.		V.		VII.	VIII.		X.		XII.	8
Gadus morrhua (Swan),	I.	II.	III.	IV.	V.	VI.		VIII.		X.		XII.	9
Rana pipiens (J. W.),	I.	II.	III.	IV.	V.			VIII.		X.			7
Bdellostoma (Muller),	I.	II.			V.		VII.	VIII.		X.			6
Myxine (Muller),	I.	II.			V.		VII.	VIII		X.			6
Lepidosiren (Owen),	I.	II.			V.			VIII.		X.			5
Amphioxus,*	I.	II.			V.								3

The instances in which the nerves are reduced to the lowest degree of numerical simplicity are very few, in comparison with those in which the larger portion, if not the whole series, of twelve exists. This simplicity is not, however, regulated by the zoölogical position of the animal; for in Frogs there exist but seven pairs of cranial nerves, whilst in most Fishes eleven are found, — the whole series, in fact,

* This enumeration of the nerves of *Amphioxus* deviates from that of Quatrefages, in his admirable memoir on the anatomy of this interesting Vertebrate. By reference to the figures of Quatrefages, it will be seen that the five pairs described by him may be easily reduced to three, if we regard the branches *l* and *m* (Plate XI.) as forming but one nerve, and corresponding to the ascending and descending branches of a common spinal nerve in the same animal, and the branches *o* and *p* (Figs. 4 and 5) as accessory filaments to the nerve *l*. The branch *m* does not vary materially in its size and distribution from the corresponding part in the pairs which precede it. The great size of the branch *l* is at once explained when compared with the greater amount of surface which it supplies, and the more acute sensibility which exists about the head. The branches *l*, *m*, *o*, *p*, would therefore form but a single nerve, which may be compared with the trigeminus; and if to this we add the optic and olfactory, we have two pairs of special sense nerves and one of cranio-spinal nerves. Rathke regards all the nerves as true spinal ones, and the brain as wholly deficient. See Quatrefages, Annales des Sci. Nat., p. 197. Oct., 1845.

which is met with in Man, except the spinal accessory. It does not appear, that in one and the same animal the number of cranial nerves is reduced so low as six pairs, except in the lowest of Fishes, namely, in the genera *Amphioxus*, *Myxine*, *Lepidosiren*, and *Bdellostoma*.*

While the cranial nerves of Frogs are less simple than in the genera just mentioned, they are more so than in any Mammals, Birds, or Reptiles, except the allied Batrachians; and they are especially interesting as showing the greatest reduction met with in any air-breathing Vertebrates. By tracing out the distribution of some of the branches of the trigeminus and vagus, we are enabled to identify them with the separate pairs of nerves into which they are resolved in the ascending series. The branch from the vagus distributed to the tongue is easily identified with the glosso-pharyngeal, and the branch to the muscles of the shoulder with the spinal accessory; thus we have a demonstration of the fact, that the vagus is made up by the union of three nerves, which in Man are so many independent pairs. In like manner, some of the branches of the trigeminus are identified with separate pairs of nerves in the higher Vertebrates, as, for example, the facial, and the motor externus; in Salamanders, the patheticus, and some (as the rectus superior, pp. 26, 27), if not all, of the branches of the motor communis. Thus the theory which makes the typical number of cranial nerves (independently of the special sense nerves) three pairs, namely, trigeminus, vagus, and hypoglossus, becomes highly probable.

As regards the special sense nerves, they have some peculiarities which seem to indicate that they are of a different order from all the rest of the nerves connected with the cerebro-spinal axis. Their peculiarities relate, — 1st, to the fact that they are connected with special organs of sense; 2d, to their development.

According to the ablest embryologists of the present day, common spinal nerves, and the same is true of the cranio-spinal nerves, do not shoot out from the respective portions of the chord to which they are attached, but are developed in the tissues where they are respectively found, and this independently of the central axis, just as the bloodvessels of the germinating membrane are developed independently of the central organ of circulation. This view, or something very near it, was maintained by Gall, and more recently has been presented by Bischoff, Kölliker, and others.

Such is not the mode of the development of the special sense nerves. According to Reichert and the more recent observers, the special sense nerves, as well as a portion of the organ of sense itself, are the result, in the first instance, of a kind of hernia, or protrusion of a portion of the embryonic cerebral vesicles, which are evolved and prolonged outwards, until they meet an involution of the common integument, and from the two results the organ of sense. The sense nerve at first seems to be formed by the contraction of the evolved tube, forming a hollow pedicle, but is subsequently filled up with nerve fibres.

One other difference may be referred to in connection with the special sense

* For the anatomy of the brain of Myxinoid Fishes, see Johannes Muller, Berlin Trans., 1837.

nerves; namely, that in the animal series they are never seen combined with motor roots, are never presented under the aspect of a true spinal or vertebral nerve. It has been maintained by Blainville and others, that the motor nerves of the eye-ball are the nerves, of which the optic is the sensitive portion, and that they are separated in consequence of the high degree of specialization of function. This assumption is readily disproved by the fact, that, of these same motor nerves, the pathetic, abducens, and some, if not all, of the branches of the motor communis, can be shown to be dismemberments of the trigeminus. The opinion of Oken, which considers the special sense nerves as appendages of the brain, is far more rational, and has the merit of being more in accordance with facts.

Cranial nerves may therefore be divided into two groups; namely, into

1. Special sense nerves:	2. Cranio-spinal nerves:
I. Olfactory,	A. Trigeminus,
II. Optic,	B. Vagus,
III. Auditory;	C. Hypoglossus;

the second including the only true serial repetitions of spinal nerves.

The determination of the typical number of cranial nerves becomes a matter of importance, in consequence of its bearing upon the philosophical anatomy of the skull. On the hypothesis that the cranium is made up of a series of vertebræ, one of the first questions which is presented is as to the number which enter into its composition. Throughout the vertebral column, as ordinarily understood, the pairs of nerves equal the number of vertebral pieces. If the cranium is reducible to the vertebral type, we might from analogy expect that there would be found a series of nerves corresponding in number to the vertebræ of which the cranium is made up. If we admit only such nerves as present the true spinal character to be indicative of the number of vertebræ, that is, those which have motor and sensitive roots, are provided with ganglia, and have a similar mode of development, then, according to the analysis given above, there being three pairs of nerves conforming to the spinal type, we should infer the existence of three vertebræ.

Anatomists, however, have not generally followed these indications, and it is a singular fact, that, in establishing the number of cranial vertebræ, they have rested their conclusions on such widely different foundations. Oken, in his latest publication, admits the existence of four vertebræ, based on the organs of sense and the lower jaw, and which he designates as the "nose vertebra," the "eye vertebra," the "ear vertebra," and the "jaw vertebra." Bojanus also recognizes four, and substitutes the "tongue vertebra" for Oken's jaw vertebra. Agassiz admitted but a single cranial vertebra, since the chorda dorsalis of the embryo did not extend beyond that portion of the base of the skull which corresponds with the basilar portion of the occiput. Professor Owen, the most recent writer on the subject, who has investigated it very minutely, and has worked out his system with admirable skill, bases his vertebral theory upon the principal subdivisions of the encephalon, from which he deduces a "rhinencephalic," "prosencephalic," "mesencephalic," and "epencephalic" vertebra. A larger number has been admitted by others, as Geoffroy St. Hilaire, Carus, and Maclise, based mainly on an unsound determination of the different osseous elements.

If we apply the analogies of the spinal chord and vertebral column to the cranium and its nerves, we ought to base our determinations on the repetitions of true spinal nerves and of the true vertebral elements. If the theory be true which reduces the cranial nerves (exclusive of the special sense nerves) to three, namely, the trigeminus, vagus, and hypoglossus, then we ought, *à priori*, to detect at least three vertebral segments. This conclusion agrees perfectly well with the determination from osteology. For the larger part of modern anatomists admit at least three vertebræ, though some admit more, but are not precisely agreed as to the exact number of elements which enter into the composition of each. These vertebræ may be designated as follows: 1st, the occipital, of which the basilar bone is the body; 2d, the parietal, of which the posterior sphenoid is the body; 3d, the frontal, of which the anterior sphenoid is the body. Professor Owen admits a fourth, of which the vomer is the body, and as this vertebra is associated with the organs of smell, he designates it as the rhinencephalic vertebra. It is through or between these three vertebræ enumerated above, that the trigeminus, vagus, and hypoglossus have their exit from the cranial cavity, and it is likewise through or between these same vertebræ that the special sense nerves make their escape. If the number of pairs of nerves of both kinds is to regulate the number of vertebræ, then, instead of three pairs, we must admit six for the cranium alone, leaving wholly out of view the face. But if the special sense nerves, for reasons already stated, can be rejected as indications of vertebræ, the cranio-spinal nerves will give us just the number which accords with osteology. In this conclusion we are supported by both osteology and neurology. Johannes Muller admits the existence of three vertebræ, and argues from them the number of pairs of cranio-spinal nerves. "According to my view, there are three vertebral nerves of the head, just as there are three cranial vertebræ. The first is the fifth or trigeminus, the second is the vagus with the glosso-pharyngeal and accessory, and the third is the hypoglossus."

The three-vertebra theory given above relates simply to the bones constituting the walls of the cranial cavity which include the brain; no account is taken of the jaws and other bones of the face, nor of the os hyoides. Professor Owen, in his system, regards these, with the scapular arch, as forming a series of four inferior or "hæmal" arches to the four cranial vertebræ, with their "neural arches," that they in fact are serial repetitions of ribs.

It would be foreign to the purpose of this paper to discuss the grounds on which these conclusions rest. Another hypothesis seems to us worthy of consideration, but which can only be stated in general terms, as follows. The teeth in the early embryonic conditions are developed from, and are dependences of, the mucous membrane of the mouth; in many Fishes these conditions are permanent; in Rays, Sharks, and other cartilaginous Fishes, the jaws or other bones which support teeth are equally developed in the internal integument or mucous membrane, and are never closely connected with the cranium except by ligament; the hyoid apparatus is likewise developed in the walls of the alimentary canal. If to these facts we add another, namely, that primarily the mouth and nostrils form a single

cavity, and are only separated after development has advanced to a certain stage, we have a strong ground for the hypothesis, that all the bones of the face which are developed in the walls of the primitive cavity of the mouth which they surround, are in their anatomical and physiological relations splanchnic, connected either with digestion or respiration, rather than parts of the endo-skeleton of animal life.

The conclusions which have been drawn from the statements made above are as follows: that in Frogs the *vagus* comprises the glosso-pharyngeal and accessory nerves; that the *trigeminus* comprises the facial, the abducens, and in the Salamanders the patheticus and portions of the motor communis; that other evidence sustains the hypothesis, that the whole of the motor communis is a dependence of the trigeminus; if to these we add the *hypoglossus* (which in Frogs is exceptionally a spinal nerve), we shall have three pairs of cranial nerves, each having all the characters of a common spinal nerve, namely, motor and sensitive roots and a ganglion; that there are no nerves to indicate a fourth vertebra, unless the special sense nerves are considered; if these are admitted as indications, then we must presuppose either two pairs of nerves to each vertebra, or the existence of six vertebræ, which is a larger number than can be accounted for on an osteological basis. The functions and mode of development of the special sense nerves we have taken as affording sufficient grounds for considering them as of a peculiar order, and not to be classified with common spinal nerves.

Section VI. — Spinal Nerves.

1. *Hypoglossus.* (Plate I. Fig. 1, 1.) — Another remarkable feature in the nervous system of Frogs, and one which has been noticed in other tailless Batrachians also, is the fact that the hypoglossal nerve (the ninth pair of Willis, and the eleventh of Soemmering), is not, as in most Vertebrates, one of the cranial nerves, but the first of the dorsal or true spinal series. Its origin is at the extreme portion of the medulla oblongata, just in front of the contraction of the chord which precedes the brachial enlargement. In reference to the determination of its true affinities, it is of consequence to notice the fact, that it is provided with two kinds of roots, of which the anterior or motor are the most numerous, consisting of a bundle of filaments attached a little nearer to the median line than the corresponding ones from the vagus. The posterior or sensitive root is quite small and scarcely perceptible; it does not appear to have been noticed, except by Volkman. Its minuteness is such, that in removing the membranes, unless especial care be taken, it will be torn away with them, and therefore easily escape detection. The presence of this dorsal or sensitive root serves to identify it with a true spinal nerve; and the identification is rendered complete by the existence of a minute ganglion near its junction with the motor root. The two kinds of root fibres, just after escaping from the spinal canal between the first and second vertebræ, unite and form a single trunk, which almost always is provided with a small sacculated appendage filled with calcareous crystals. The trunk of the nerve descends along the sides

of the neck, crosses the vagus and its laryngeal branch, and, running nearly parallel to the glosso-pharyngeal, passes along the genio-hyoid muscle as far as the symphysis of the lower jaw; it then ascends, in company with the last-mentioned nerve, into the substance of the tongue, and is lost among its muscular fibres. This description applies to the principal trunk; in its progress, however, it gives off numerous branches, repeating very nearly the distribution of the same nerve in the human body; in other words, it is distributed to the muscles which move the os hyoides and tongue. The following branches were traced: 1st, a branch to the muscles attached to the vertebral column in its immediate neighborhood and to the omo-hyoid; 2d, to the sterno-hyoid; 3d, to the hypoglossus; 4th, genio-hyoid; 5th, genio-glossus. Galvanism proves still further the relation of these muscles to the hypoglossal nerve; if this agent be applied to the main trunk near the vertebral column, convulsions are simultaneously produced throughout the whole hyoid and glossal group; but nothing of the kind is noticed, as has already been stated, when it is applied to the glosso-pharyngeal, which has a direction so nearly parallel with it.* On entering the base of the tongue, the hypoglossus, like the glosso-pharyngeal, is thrown into zigzag folds, which adapt it to the peculiar extensibility of that organ.

The descriptions of this nerve by different anatomists are somewhat discordant, and it is therefore a matter of some interest that they should be compared. Vogt, in the memoir already referred to, says: "Volkman describes this nerve as the first nerve of the neck, which it is according to its exit, but not according to its origin and its course. He also represents its origin as at some distance from the vagus, and the nerve as if it were provided with a ganglion. I thought I could at least find the last in Frogs, but was soon convinced of my error." "The hypoglossus takes its origin close to the vagus, but nearer to the median line, from the under surface of the medulla oblongata, and, instead of going directly outwards, bends backwards close to the under side of the medulla within the pia mater, and when opposite to the foramen makes a sudden bend outwards, so that, if the pia mater is untouched, it has the appearance of having its origin opposite to the hole, and at some distance from the vagus. Has Volkman been deceived by this disposition?" "That, as Volkman says it does in Frogs, it takes its origin with two roots, and has, as he draws it, a ganglion, is certainly not the case in Toads, and I believe that no error on my part exists." Stannius distinctly, but incorrectly, asserts, that the hypoglossus has no posterior roots. "The spinal nerves always arise by two roots; the first two cervical nerves appear to form an exception to this rule, not only in the naked Reptiles, where they take the place of the hypoglossus, but also in some of the scaly ones." †

According to the dissections which form the basis of this memoir, Volkman's description is quite correct, both as to the existence of two kinds of roots and of the ganglion; also as to the position on the side of the medulla. The roots of the

* The same result, as regards its function, is shown by the experiments of Dr. Waller. — Philosophical Transactions, 1850.

† Stannius, Manuel d'Anatomie Comparée, Tom. II. p. 200.

hypoglossus are in part connected by the arachnoid. In *Bufo Americanus* I have found the hypoglossus arising very nearly as Vogt has described it.

Vogt's classification of this nerve among the true cranial nerves does not seem to be satisfactorily sustained, and certainly will not hold as regards Frogs. In them it certainly has all the characters of a common spinal nerve; viz. two kinds of roots, a ganglion on one of them, a mass of crystals attached as in the spinal nerves, and making its exit at an intervertebral foramen. There is still another anatomical character, though perhaps not an important one, which allies it to the spinal more than the cranial nerves; this is the primitive direction of the nerve roots backwards instead of forwards, as is the case with the cranial nerves.

II. *Brachial Nerves.* (Plate II. Figs. 1, 2.) — These are comparatively simple. In most of the higher Reptiles which have limbs, they consist of three or more pairs, which subsequently unite and form the brachial plexus, which in turn gives its branches to the upper extremity. In Frogs, however, only a small filament is given by the third spinal to the brachial nerve, and thus an approach merely to a brachial plexus exists. All the nerves to the arms, with the exception of the above-mentioned branch, are supplied by the single trunk of the second pair, which is attached to the spinal chord by several distinct motor and sensitive filaments. The trunk passes to the upper part of the arm before it divides, giving off, however, collateral branches to the muscles of the scapular and clavicular regions; also a branch to the pectoral muscles and a circumflexus humeri. The remaining portion of the nerve forms the ulnar and radial branches.

III. IV. V. VI. are the smallest pairs of the spinal nerves. They all arise by single anterior and posterior roots, and are mainly distributed to the muscles and skin of the back and the abdomen. The distribution of the cutaneous nerves will, however, be described hereafter.

Lumbar Nerves, VII. VIII. IX. These likewise all arise by single anterior and posterior roots from the spinal chord, but they are very much longer than those of the preceding pairs, in consequence of the greater distance of their origins from the intervertebral foramina, where the anterior and posterior filaments unite. The three lumbar nerves thus formed descend to the neighborhood of the hip joint, where the eighth and ninth pairs become intimately blended (*c*), and at the same time receive an anastomosing branch from the seventh (*b*). After giving off the branch just referred to, the seventh pair makes a turn outwards and upwards, so as to give its terminal filament to the posterior walls of the abdomen; from the convex side of its curved portion are given off numerous branches, which descend in a parallel series and are distributed to the skin of the thigh (*g*). This nerve, from the fact that it escapes at the inguinal region, and in consequence of its distribution to the leg, may be regarded as identical with the *cruralis*.

By the union of the eighth and ninth, with a portion of the seventh, a large sciatic trunk is formed, and this descends nearly to the knee without division, giving off, however, as collateral branches, a glutæal nerve (*e*), and two larger muscular nerves to the thigh (*f*). At the knee the sciatic is divided into two branches, the tibial and peroneal nerves (*h* and *i*).

X. *Coccygeal Nerve;* 10. This is the last of the series of spinal nerves, and from its minuteness does not appear to have attracted notice; consequently, the number of pairs is usually enumerated as nine. It is most easily detected on either side of the coccyx beneath the muscles extending from it to the ilia. If traced from its termination towards the chord, it will be found entering the cavity of the coccyx by a foramen pierced quite obliquely in its walls at a short distance from the anterior extremity of the bone. This nerve is attached to the chord by both kinds of roots, just beyond the third crural or ninth pair of spinal nerves. The detection of this nerve has especial interest, since it demonstrates conclusively the homology of the anomalous-shaped coccyx with a true vertebra, and also makes the number of nerves and vertebral pieces equal.

Cutaneous Branches of the Spinal Nerves. — The skin of Frogs, it will be remembered, is attached only to a very limited extent to the parts beneath, so that there is a series of large subcutaneous cavities, which are for the most part separated from each other. The first or dorsal subcutaneous cavity covers the whole region of the back, extending from the occiput to the posterior part of the trunk, and limited on the sides by the union of the skin with the muscles beneath, on a line extending from behind the eyes as far as the pelvis. The lateral cavities, one on each flank, are limited by the lines described above, and two others, one on each side, extending from the axilla to the pelvis. The fourth or abdominal cavity is comprised between the two last, and extends over the whole abdominal region.

The cutaneous nerves escape through the muscles to the skin, mainly in three directions; namely, on each side of the median line on the back, and at the upper and lower lines which limit the lateral subcutaneous cavities. The dorsal branches are in pairs, nine in number, and corresponding with the first nine vertebræ. In front of the scapula is a minute branch of this series, which is derived from the hypoglossus, and to this same series should be added the cutaneous filament from the vagus distributed to the skin near the occiput. On the upper lateral line eight pairs are given to the skin; on the sides in the lateral cavity five pairs descend to the lower lateral line, where, with three others given off more posteriorly, they enter the skin. These last branches seem to be the ones liable to the greatest irregularity. The existence of a dorsal cutaneous branch from the vagus and hypoglossus both, added to the facts already stated under another head, go still further to show their identity with common spinal nerves.

Crystal Capsules attached to the Spinal Nerves. (Plate I. Fig. 1, *i, i.*) — The existence of certain white bodies on either side of the vertebral column in Frogs seems for a long time to have attracted attention. They are referred to by Blasius, in his *Anatome Animalium*,* and are figured by Swann,† though he gives no descriptions. Wagner mentions them as follows: — "The ganglia admit of being very readily

* "Ab utraque spinalis medullæ parte, substantia quædam albicans calcis instar adhæresciť, quam vasa plurima perreptant; substantia hæc sali volatili est analoga, cum ex observatione Swammerdammii affuso spirito acido effervescat. Cui usui tot vasorum plexibus inserviat admodum obscurum est." — *Gerardi Blasii Anatome Animalium*, Amstellodami, 1681, p. 291.

† Comp. Anat. Nerv. Syst., Plate VII. Figs. 5, 6.

demonstrated, lying upon the sides of the vertebral column; they are situated near those small white vesicles, which protrude by becoming swollen, chiefly during the spring of the year, and contain numerous microscopic calcareous crystals." * Stannius describes them as an accumulation of the white substance which covers the pia mater around the nerves where they escape from the spinal canal, and which, under the microscope, has the appearance of a mass of crystals. † Professor Owen has usually called attention to them in his annual Hunterian lectures, though he has published nothing in relation to them.

As I have seen them in dissections, they are subject to some variety, but exist on the trunks of all the true spinal nerves, the hypoglossus included, and invest them more or less completely at their exit from the spinal canal, occupying the space between the transverse processes of two adjoining vertebræ. The capsule is a very thin membrane, sometimes having a diameter of two or three lines; its surface is minutely lobulated, an appearance which results from the existence of numerous partitions within, forming many small cavities, which communicate, though not very freely, with each other. The contents of these pouches are vast numbers of exceedingly minute crystals of a somewhat oval form (Plate I. Fig. 18), pointed at their extremities, and comparable in shape to a lemon-seed, but sometimes presenting well-defined angles.

These capsules are not in any definite proportion to the size of the nerves to which they are attached, those of the brachial, for example, which is one of the largest pairs of nerves, being much smaller than those connected with the dorsal nerves, which are of less size. As to the statement by Wagner, that they are found more swollen in the spring, this condition has not been noticed in the instances which have fallen under my observation. I have detected them of nearly equal dimensions at all seasons of the year, whether examined in spring, summer, late in the autumn, or even in midwinter. They do not belong exclusively to the adult period, but, as stated by Stannius, I have found them in the larvæ at different periods, even before the development of arms and legs. Dissections of other than Raniform Batrachians have not led to their detection; I have not found them in *Siren*, *Menobranchus*, *Bufo*, or *Salamandra*, but have seen them in *Rana fontinalis*, *R. halecina*, and *R. palustris*. They seem to be in these species constant appendages to the spinal nerves. The crystals which these capsules include are similar in size and form to those contained in the vestibule of the ear; in the latter case they are in contact with the extremity of the nerve, but in the former they are simply attached to its sheath.

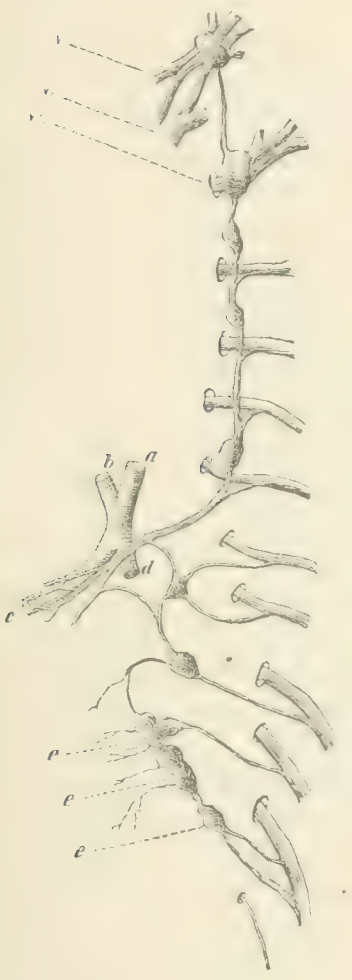
Section VII. — Sympathetic Nerve.

The small number to which pairs of spinal nerves are reduced involves, as a matter of course, a sympathetic nerve of a corresponding degree of simplicity. It is connected with all of the nerves from the trigeminus to the third lumbar nerve in-

* Comp. Anat. Verteb., Part. I. p. 151. † Manuel d'Anat. Comp., Tom. II. p. 200.

clusive; at its anterior extremity, no filament was traced to the motor communis, though analogy would lead us to expect one; nor at the other extremity was any traced to the coccygeal pair. The filament from the ganglion of the trigeminus to the vagus is very minute, and, as will be seen by reference to the figure, no sympathetic ganglion is developed upon it. Precisely similar conditions exist, according to Fischer, in *Bombinator igneus*, *Pelobates fuscus*, and *Hyla arborea;* also, according to Vogt, in *Bufo pantherinus*. From the posterior extremity of the vagal ganglion, the nerve extends backwards as far as the fourth dorsal, receiving filaments from the hypoglossal, brachial, and the two succeeding spinal nerves, and where each of these filaments joins the sympathetic trunk, a distinct ganglion is formed. After it receives its fibres from the fourth spinal nerve, it is enlarged, leaves the side of the vertebral column, and forms, with the nerve from the opposite side, a plexus around the mesenteric artery, from which it is distributed to the spleen, stomach, and intestines.

Fig. 4.



V. Trigeminus.
VI. Auditory nerve.
VII. Vagus.
a and *b*. Right and left aortas at their union.
c. Mesenteric artery.
d. Descending aorta.
e, *e*, *e*. Renal and genital ganglia.

The branches of the fifth and sixth pairs unite and form a ganglion, from which a small branch goes to the splanchnic plexus, and another backwards to the ganglion of the next nerve (seventh), which is the first of the crural or lumbar pairs; this last ganglion in turn sends a branch back to the ganglia of the eighth and ninth pairs, *e*, *e*, *e*. The filaments given off from the group just mentioned are distributed almost entirely to the kidneys and neighboring viscera, following the course of the bloodvessels which ramify upon them.

It is seldom that we have a more favorable opportunity offered for studying the minute structure of the ganglia than in the sympathetic system of Frogs, where they are both small and transparent. I have not been able to determine any thing different from what was previously known with regard to their minute structure. Fig. 10, Plate II. represents the ganglion just behind the third spinal nerve; *a*, *b* is the principal trunk of the nerve; *c* is the sympathetic branch; *d*, *d*, the sympathetic trunk in front of and behind the ganglion. Some of the fibres of the sympathetic pass through the ganglion without separating; others, leave the principal fasciculus, and become more or less mixed up with the nerve cells entering into the composition of the ganglion. The branch *c* divides into two

principal fasciculi, one of which goes towards the head, and the other backwards; but some of the same fibres leave the principal bundles and run irregularly among the cells. The sympathetic nerve fibres are more minute than the spinal, and some of the latter may be readily traced into the sympathetic, where they are distinguished by their size. A portion of the root *c* is, however, made up of the more minute sympathetic fibres. The ganglion cells are well defined, lightly pressed together, so that their spherical form is but slightly interfered with, and contain a few granules of a yellowish color. In no instance was a caudate cell noticed, nor any connection between the cells and the nerve tubes. The latter passed among, but not into, the cells. Each ganglion formed by the union of the spinal and sympathetic nerve may therefore be described as consisting of the following elements: 1st, a mass of ganglion cells; 2d, a fasciculus of sympathetic fibres, some of which last become detached from the principal bundle, and, after passing irregularly among the cells, either return to the fasciculus from which they came, or join one of the other fasciculi; 3d, a double series of filaments from a spinal nerve, one series passing forwards and the other backwards; some of the fibres of each series become detached from their fasciculi, and pass irregularly among the ganglion cells.

Besides these ganglia connected with the spinal nerves, others more minute appear to be formed wherever two sympathetic branches cross each other, in which case the fibres of the different fasciculi separate and form an open but irregular series of meshes, in which ganglion cells are deposited. In the formation of each ganglion, it seems to be a general rule that there is an interchange of filaments between the two or more trunks which enter into its formation; also a deposit of ganglion cells in the meshes formed by the separated fibres. In this last respect it differs from a plexus, which consists merely in the interchange of filaments of two adjoining nerves, without any deposit of nerve or ganglion cells.

From what has been stated with regard to the relation of nerve tubes and nerve cells in the brain, in the spinal chord, and sympathetic, it seems almost certain that continuity of structure between the two histological elements of the nervous system is in the species here described not essential to nervous action. The only conditions which direct observation gives evidence of is close proximity, but not absolute continuity.

EXPLANATION OF THE PLATES.

PLATE I.

In Figs. 1 to 9 inclusive, corresponding parts are indicated by the same letters.

Olfactory Lobes	A.
Cerebral Lobes	B.
Corpora Striata	C.
Optic Thalami	D.
Pineal Body	E.
Pituitary Body	F.
Optic Lobes	G.
Cerebellum	H.

Fig 1. Cerebro-spinal axis seen from beneath, enlarged four times, linear measurement, showing the origins of the cranial and spinal nerves.

I. Olfactory nerve; II. Optic nerve; III. Motor communis; IV. Patheticus; V. Trigeminus.

a, portio dura, or facial, which joins the ganglion of the trigeminus; *b*, motor externus or abducens, which also joins the ganglion of the trigeminus; *c*, "facial," a nerve formed by the union of a branch from the trigeminus with another, *d*, from the vagus.

VI. Auditory nerve.

VII. Vagus. *d*, branch joining the "facial"; *e*, motor root; *f*, cutaneous branch; *g*, *h*, glosso-pharyngeal.

I. First enlargement, or medulla oblongata.

L. Brachial enlargement.

N. Lumbar, or crural enlargement.

O. Coccygeal portion.

i, *i*. Crystal capsules connected with all of the spinal nerves, except the tenth pair.

k, *k*. Ganglia of the spinal nerves.

Fig. 2. Dorsal view of the cerebro-spinal axis, enlarged two diameters, linear measurement. A, B, D, E, G, H, the same as in Fig. 1. K, fourth ventricle. L, posterior pyramidal tract, enlarged at each of the bulgings of the chord; the posterior pyramids form a similar enlargement for the medulla oblongata, but are separated by the fourth ventricle.

Fig. 3. Side view of the cerebro-spinal axis. Letters indicate the same parts as in the preceding figures.

Fig. 4. Brain and spinal chord of *Bufo Americanus*. References as before.

Fig. 5. Brain of *Menobranchus lateralis*. The optic lobes, G, are fused, as in *Menopoma*, and as are the olfactory lobes in Frogs and the cerebral lobes in some Plagiostome Fishes.

Fig. 6. Transverse section of the brain, showing the cavities of the olfactory, cerebral, and optic lobes.

Fig. 7. Longitudinal section of the brain, a little to the left of the median line. The corpus striatum, C, is here exposed to view, also the body within the optic lobes, G.

Fig. 8. Longitudinal section of the same on the median line; the cut surfaces are shaded. L is the entrance to the lateral ventricle, and the space between this opening and the olfactory lobes, A, indicates the extent of the fissure which extends from the upper to the under surface, completely separating the cerebral lobes from each other.

Fig. 9. A plan, showing the connection between the spinal chord and the different portions of the brain.

Fig. 10. Nerve cells or vesicles from the cerebral lobes.

Fig. 11. Pineal body, consisting almost wholly of loops of bloodvessels; the whole surface is covered with ciliated epithelium, as at *a*.

Fig. 12. A small portion of the pineal body, magnified, showing an inclosed loop of bloodvessel, and the epithelial covering.

Fig. 13. A small portion of chord from the median line, showing the nerve tubes which pass from one side to the other in the gray substance.

Fig. 14. A small portion of the chord highly magnified, showing the entrance of one of the roots of a spinal nerve, as seen on the surface.

Figs. 15 and 16. Portions of the chord from the tail of a tadpole, showing the existence of a central mass of cells with white columns on each side; the nerve roots enter these last, and ascend towards the trunk. A few transverse fibres only are seen.

Fig. 17. The under surface of the lower jaw, and sublignal region of a Frog. M, lower jaw; V and V^1, branches of the facial portion of the trigeminus; the same as *i*, *k*, and *h*, Fig. 2, Plate II.

Fig. 18. Calcareous crystals from the crystal capsules of the spinal nerves.

PLATE II.

Fig. 1. General view of the spinal nerves, of the natural size. 2, brachial nerves. *a*, anastomosing filament from the third spinal nerve, forming a simple brachial plexus. The three following nerves are distributed to the walls of the abdomen. 7, 8, 9, lumbar nerves; *c*, union of the 8th and 9th with a branch from the 7th, forming the single sciatic trunk; *e*, gluteal nerve; *f*, nerve to muscles of the thigh; *g*, branches of the crural nerve, distributed to the skin of the thigh; *h*, tibial, and *i*, peroneal nerves.

Fig. 2. Some of the details of the distribution of the trigeminus (V.) and vagus (VII.) nerves. *a*, orbitar branch of trigeminus; *b*, palatine branch; *c*, terminal branches to vomerine teeth and internal nasal opening; *d*, anastomosing branch to upper maxillary nerve; *e*, upper and lower maxillary nerves united; *g*, "facial," formed by the union of a branch from the trigeminus and vagus nerves; *h*, tympanic branch; *i*, jugular branch; *k*, lower jaw branch; the last two are the same as V and V^1, Plate I. Fig. 17; *l*, *n*, branch of vagus to heart, lungs, and stomach; *m*, glosso-pharyngeal.

Fig. 3. Side view of the branches of the trigeminus. *a*, orbitar branch; *b*, palatine branch; *c*, filaments to inner nasal orifice; *d*, union of palatine and upper maxillary branches; *e*, upper maxillary nerve; *f*, lower maxillary nerve; *g*, "facial."

Fig. 4. Right eye seen from above. III. Motor communis entering superior and internal rectus muscles. IV. Patheticus distributed to the superior oblique muscles. V^a. (on the left of the figure), orbitar branch of trigeminus (should be marked V.); V^a. (on the right), the *abducens*, which is a branch of the trigeminus, distributed to the external rectus.

Fig. 5. IV. Patheticus. V. Orbitar branch of the trigeminus, from which a filament is given off, crossing the preceding, and which appears to communicate with it.

Fig. 6. Right eye seen from below. III. Motor communis giving branches to rectus inferior and rectus internus, also to the obliquus inferior muscles. V. Branch of trigeminus to the external rectus, *abducens*.

Fig. 7. Tadpole, showing general form of the chord previous to the development of legs.

Fig. 8. Tadpole, showing changes in the form of the chord after the development of the legs and before the absorption of the tail.

Fig. 9. Tadpole, showing the temporary branches of the vagus; *a*, branch of vagus giving off dorsal branch, *b*, distributed to the fin of the tail, and the lateral nerve, *c*; *d*, branches of vagus passing along the branchial arches. The descending branches along the side of the abdomen are spinal nerves, which escape from beneath the muscles, and pass beneath the lateral nerve, but do not communicate with it.

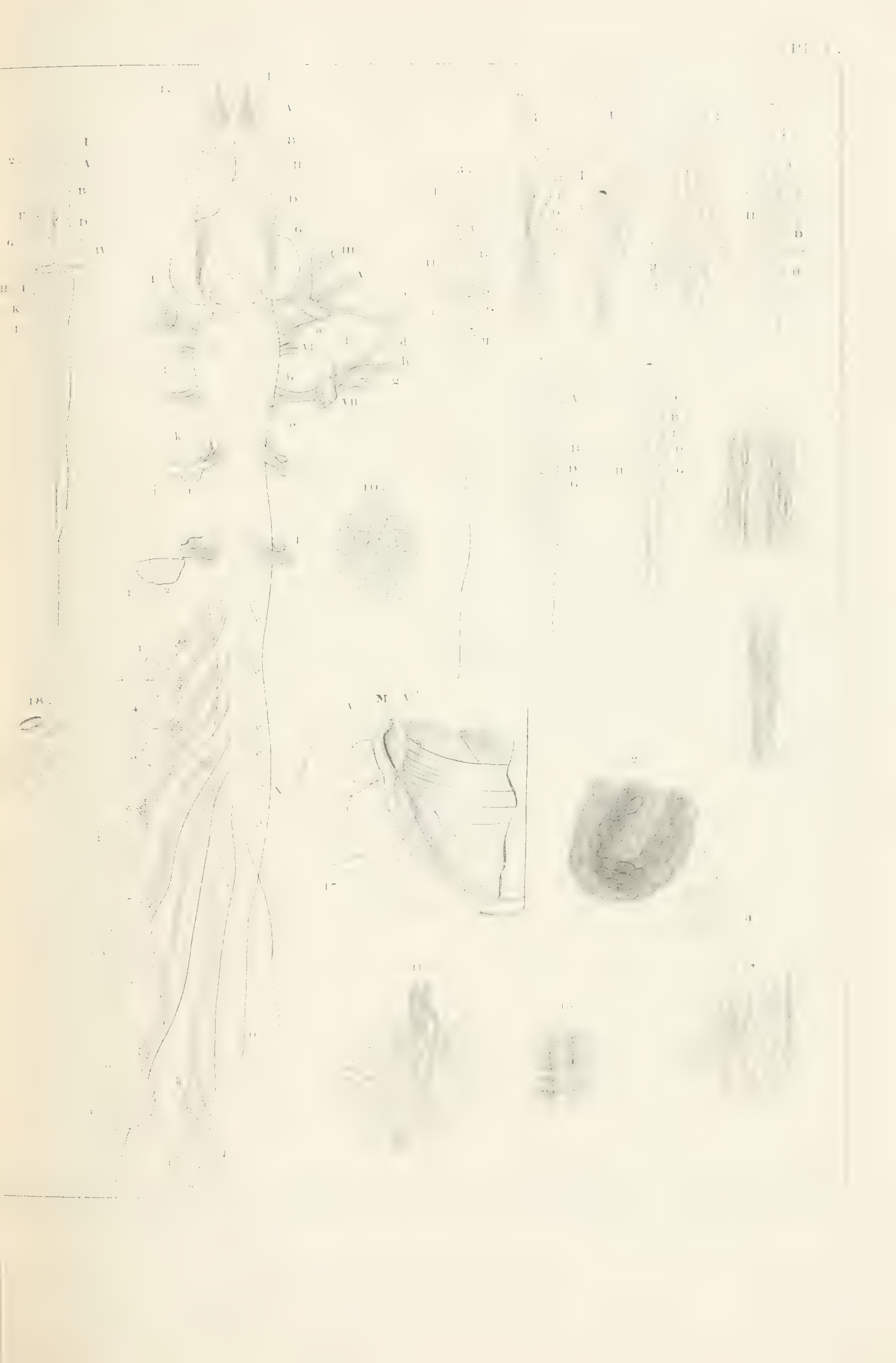
Fig. 10. Ganglion of the sympathetic nerve. *a*, trunk of the third spinal nerve; *b*, muscular and cutaneous portion; *c*, branch to the ganglion, dividing into ascending and descending filaments, which become separated from each other, and inclose ganglion cells; *d*, *d*, sympathetic fibres, which extend through the ganglion, in passing which their filaments separate and include ganglion cells.

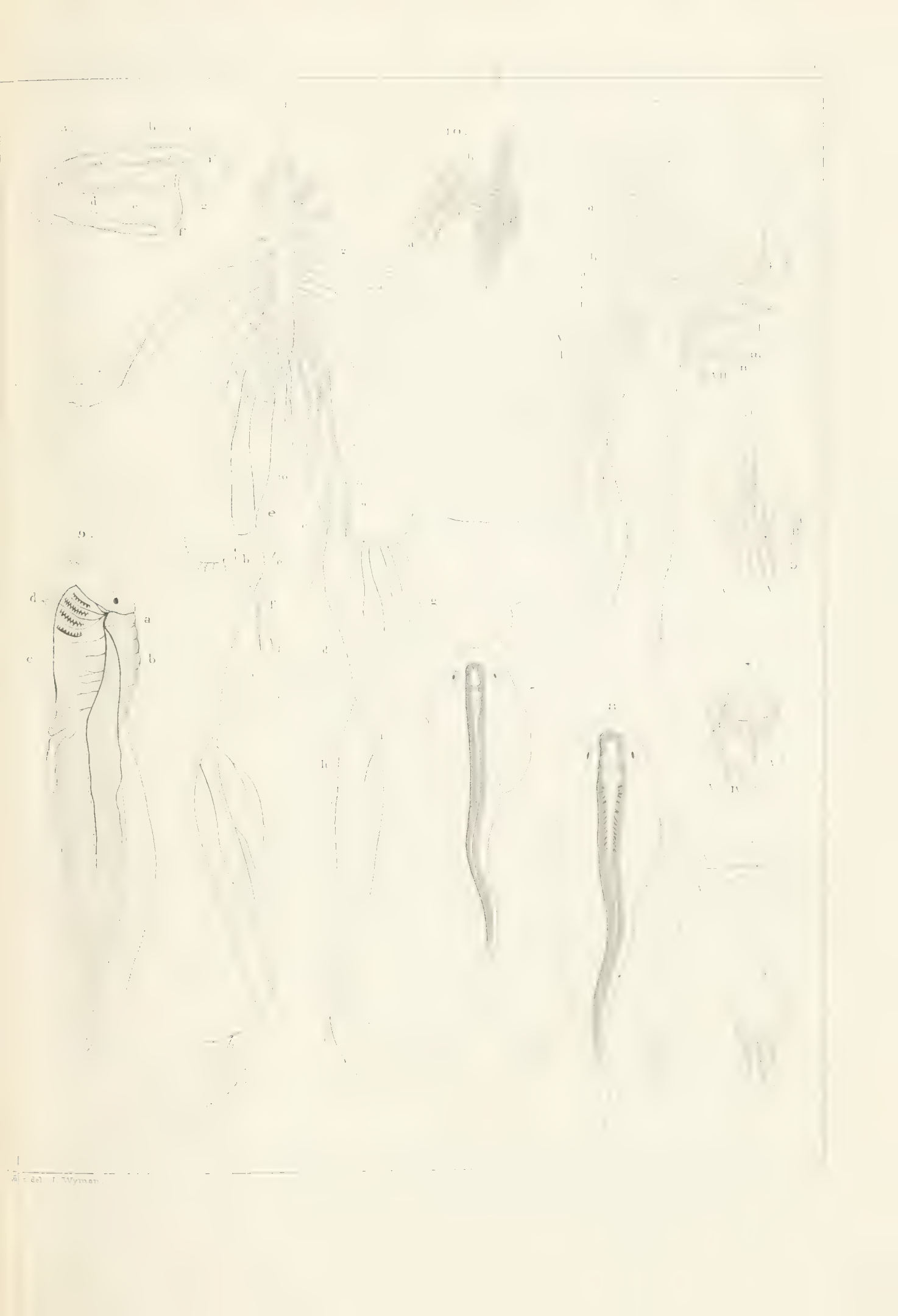
Fig. 11. A, olfactory pouch; B, olfactory nerve; C, olfactory lobe; D, cerebral lobes; V, V, orbitar branches of the trigeminus, crossing the olfactory nerve, sending filaments to the olfactory pouch, and terminating in the skin of the upper lip.

PUBLISHED BY THE SMITHSONIAN INSTITUTION,

WASHINGTON, D. C.,

MARCH, 1853.





SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

NEREIS

BOREALI-AMERICANA:

OR,

CONTRIBUTIONS TO A HISTORY OF THE MARINE ALGÆ
OF NORTH AMERICA.

BY

WILLIAM HENRY HARVEY, M. D., M. R. I. A.,

KEEPER OF THE HERBARIUM OF THE UNIVERSITY OF DUBLIN: PROFESSOR OF BOTANY TO THE R. D. S.:
AND CORRESPONDING MEMBER OF THE NEW YORK LYCEUM OF NATURAL HISTORY.

PART II.—RHODOSPERMEÆ.

[ACCEPTED FOR PUBLICATION, JULY, 1852.]

COMMISSION

TO WHICH THIS PAPER HAS BEEN REFERRED.

Prof. J. W. Bailey,
Dr. Asa Gray.

Joseph Henry,
Secretary S. I.

SUB-CLASS II.

RHODOSPERMEÆ, OR RED ALGÆ.

DIAGNOSIS. *Plants* rosy-red or purple, rarely brown-red, or greenish-red. *Fructification* of two kinds, diœcious:—1. *Spores* (*gemmidia*, J. Ag.) contained either in external or immersed conceptacles, or densely aggregated together and dispersed in masses throughout the substance of the frond: 2. *Tetraspores* (*sphœrospores*, J. Ag. *gemmules*, Thw.) red or purple, either external or immersed in the frond, rarely contained in proper receptacles; each tetraspore enveloped in a pellucid skin (*perispore*) and at maturity separating into four *sporules*. *Antheridia* (not observed in all) filled with yellow or hyaline corpuscles. *Marine, with one or two exceptions.*

The most obvious characteristic of the plants of this sub-class is their colour, though this varies through every shade of red and purple into red brown, or pure brown; and degenerates, under the influences of sun-light and shallow water, into orange, yellow, or dull green. Still, some faint tint of redness, or the absence of *olive-green* or *grass-green*, prevents the student from confounding the faded *Rhodospermeæ* with either of the other groups into which the Algæ are divided.

Their most remarkable and distinctive character however lies in their *double system* of fructification; two descriptions of spore-producing organs having been found in almost all these plants, and always being developed on *different* individuals of each species. Thus, these Algæ are strictly *diœcious*, though in a different manner from other diœcious plants; for here it is not stamens and pistils (or their analogues) which are borne on different roots; but, *some* individuals of a species produce only one kind of pistil or sporiferous organ, and *others* of the same species constantly produce a sporiferous organ of a different kind. These diverse fructifications do not appear to be different phases of the same organ, like the two sorts of flowers found in some *Polygalæ*, *Leguminosæ* and *Malpighiaceæ*, etc.; but are in their origin and development perfectly distinct, and formed with the greatest regularity, following fixed laws. The *spores* developed in either system are equally capable of reproducing the species; and as the two kinds are always formed on different individual fronds, the *idea* of each species of these plants includes two individuals, and is not complete unless both are known. Hence the necessity, in forming our generic groups, to ground them on characters taken from the peculiarities of both fructifications.

Perhaps the natural explanation of this double fructification is to regard one form of reproductive body as the true *spore*, supposed to be fertilized through the agency of an *antheridium;* and to consider the other to be merely a gemmule or bud, here

reduced to a single cell, cast off by the parent plant and capable of continuing an independent existence. If this be the true explanation of the phenomena, we have still to decide (and from analogy only, for evidence of fertilization is wanting) to which of these bodies we shall give the name of *spore*, and which we shall call *gemmule*. And here different botanists take different views, the positive evidence, as it seems to me, being nearly equally in favour of either. Having no new facts to bring forward, I shall not argue this question here; but, adopting the names *spores* and *tetraspores* for these reproductive cells respectively, shall endeavour briefly to describe their development and modification.

1. The *spores*, then, or *gemmidia* of J. Agardh, are always congregated in a more or less definite mass, tuft, or cluster, which we shall here call the *Sporiferous-nucleus* (*Nucleus cystocarpii*, J. Ag.) Each *spore* is a cellule, having a gelatino-membranaceous, hyaline coat, and containing a dense, subsolid, homogeneous, deeply coloured starchy mass or *endochrome*, which, on being expressed, breaks up into an impalpable granular dust. The *sporiferous nucleus* is either wholly naked (as in *Wrangelia*, *Callithamnion*); immersed in the substance of the frond (as in *Grateloupia*, *Halymenia*, *Dumontia*, etc.); lodged in wart-like tubercles (as in *Polyides*); or contained within hollow *conceptacles* (or *cystocarpia*, Kütz.) of various forms, which are either dispersed through the frond and partially immersed in it; or are borne on the ends or sides of the branches, on the midrib of leaves, or on proper fructiferous ramuli developed from some part of the stem, or of the margin or disc of the foliations. In all cases of external *conceptacles* they appear to be transformations of the ends of the branches, or of lateral ramuli; the transformed branch or ramulus being usually very much shortened, often reduced to a point. And all immersed *sporiferous nuclei* are formed from the interior strata of cells, and have generally if not always, a connection with the medullary or central stratum.

The *sporiferous nuclei* are of two kinds, distinguished by the manner in which the spores are developed in each. In families of the highest structure (Des. miospermeæ) the *nucleus* consists of a tuft of articulated, moniliform filaments, or *spore-threads*, radiating to all sides from a central point, or growing from a proper placenta lodged within a conceptacle. In these nuclei a *single* spore is formed within one or more of the cells of the filaments; and the *spore-thread* at maturity is thus more or less changed into a string of spores. In some, all the cells are changed into spores; in others, the terminal cell is alone fertile. In the less organised families (Gongylospermeæ) the *nucleus* is formed either from a single mother-cell, from several detached mother-cells, or from such cells imperfectly joined together in moniliform strings issuing from a central point, or growing from the placenta of a conceptacle. Each mother-cell, which is at first filled with a homogeneous endochrome, becomes, by repeated cell-division, converted into a cluster of *spores*, at first retained within its walls; afterwards, on the bursting of the wall, dispersed. Thus by the evolution of one cell, a *favella*, or simple globose nucleus containing many angular spores within a hyaline periderm, is formed. By the evolution of several detached but adjacent mother-cells, a *favellidium* or compound *favella* results. And by the similar evolution of the cells of the moniliform series, the highest form of *favellidium* is produced. In all these cases the general

nucleus, as well as the particular *nucleoli*, is surrounded by a gelatinous or submembranaceous hyaline periderm, derived from the cell walls of the transformed cells.

The classification adopted in this memoir being based on the structure of the *nuclei*, the student will do well, if possible, to master the principles of development now explained. In many cases the structure may be easily seen by viewing under the microscope longitudinal sections of the conceptacle, particularly those of the series *Desmiospermeæ*, where the changes between ripe and unripe fruit are less marked than in the *Gongylospermeæ*. In such plants as *Polysiphonia* and *Laurencia* no careful cutting is necessary, simply bruising the conceptacles between two glasses being sufficient to expel the nucleus. In the *Sphærococcoideæ* and in *Gelidium*, &c. thin cuttings easily made after a little practice under a simple lens, must be viewed by transmitted light. In the *Gongylospermeæ* the proper structure of the *nuclei* is often difficult to be ascertained, owing to the confused crowding of spores which results from the continual self-division of the fertile cells. It may be necessary to examine thin cuttings of various ages in order to determine whether the nucleus be formed from one or many mother-cells. But in most cases where the nucleus is of a large size, very dense, with indications of internal septa, such an origin may be taken for granted. Instances of simple nuclei or *favellæ* favourable for examination occur in *Callithamnion*, *Grateloupia*, *Gloiosiphonia* ; and of compound nuclei or *favellidia* in *Chondrus*, *Gigartina*, *Calophyllis*, and *Cystoclonium*.

2. *Tetraspores* (*Sphærosporæ*, J. Ag. *Tetrachocarpia*, Kütz.) are commonly formed in compound fronds by the evolution of some of the cells of the cortical layer, or in the simple, filiform kinds by the transformation of the ultimate ramuli. They are either dispersed equally through the surface cellules of the whole frond ; or confined to the ramuli ; or grouped together in definite spots called *sori* ; or lodged in external wart-like excrescences (*nemathecia*) ; or in proper leaflets (*sporophylla*) ; or in ovate or lanceolate, podlike receptacles (*stichidia*). Wherever placed, they agree in structure ; each *tetraspore* containing, within its hyaline, gelatino-membranaceous coat or *perispore*, a dense, four parted, deeply coloured endochrome, dividing at maturity into four (rarely eight or more) *sporules*. The mode of division of the nucleus varies in different species, and should be carefully observed by the student, as generic distinctions are sometimes grounded on this character. In some tetraspores the mass is quartered by two lines crossing each other at right angles in the centre ; such are called *cruciate* tetraspores. In others the mass splits into four unequal parts, three of which only are visible on the lateral view, divided from each other by three lines radiating from the centre ; such are called *tripartite*, *ternately parted* or *triradiate* tetraspores. Again, there are others, of an oblong or cylindrical form, divided by three parallel, transverse lines into annular portions ; and such are called *zonate*, *annular*, or *transversely parted* tetraspores.

The natural arrangement of the Rhodospermeæ in Orders and genera offers many more difficulties to the student than that of the Melanospermeæ, owing to the greater complication of the organs of fructification ; the minuteness of the parts which require to be dissected that their proper structure may be understood ; the much more varied forms which the *frond* assumes ; but especially the great diversity

of *internal* structure which prevails among plants that have *externally* a close resemblance. This last peculiarity compels us, in order to understand their true affinities, to acquire an intimate knowledge of the anatomy of the frond; and this is only to be learned, in the compound species, by a patient examination of transverse and longitudinal slices, always a tedious, and sometimes a difficult process. In the generic distribution proposed by the earlier systematic writers, the external form of the conceptacle, or the colour and substance of the frond, were chiefly considered; in most cases, irrespective of the anatomic structure. Thus, plants the most opposite in internal composition, and producing fructification fundamentally diverse, were often placed in the same genera. A notable instance of such unnatural association occurs in the old genus, *Sphærococcus*, Ag. which included almost every round-fruited species which had no other "local habitation or name;"* and this at the arbitrary will of the author, for the generic character assigned to the assemblage could not be said to apply to a tithe of the species placed in it. Dr. Greville first reformed this group, separating *Rhodymenia*, *Gracilaria*, *Chondrus*, *Phyllophora*, *Gelidium*, *Gigartina*, *Hypnea*, and *Iridæa* from it, a sufficient evidence of the chaos it then contained. No doubt Dr. Greville's system was a vast improvement on that of the elder Agardh; but his genera were often founded on the external habit of the frond, and sometimes included plants as little related *naturally* to each other as those placed in the old group *Sphærococcus*. Thus, *Rhodymenia*, Grev. comprised all the old *Sphærococci* with a red, expanded, membranous, ribless frond, no matter what the internal structure of the frond, or of the fructification. Examination has shown the structure of both frond and fruit to be extremely different among the plants thus associated, and compelled the separation of the new genera, *Calophyllis*, *Rhodophyllis*, *Rhizophyllis*, *Euthora*, and *Calliblepharis*, while of those that remain some belong to *Gigartina*, some to *Gracilaria*; and of the sixteen species enumerated by Dr. Greville, only five belong to the modern genus *Rhodymenia*; the rest dispersing into three different Orders. This example may suffice. Dr. Greville's system was published in 1830. The next decided improvement in system was developed in 1841–1842, by Professor J. Agardh,† who, in describing the Algæ of the Mediterranean and Adriatic, took occasion to reform the generic characters, by introducing into the diagnosis the internal structure of the frond, and by more accurately describing the fructification. Much remained still to be accomplished, and new genera founded on the reformed principles were added by Montagne and others. In 1843 Kützing published his "*Phycologia Generalis*,"‡ accompanied by eighty anatomical plates of unrivalled excellence and beauty. In this great work many new genera were defined and illustrated, and a new system of distribution was proposed. The chief excellencies of the book are its anatomical illustrations: its faults are, the needless alteration of established names; the introduction of unnecessary glossology; and the multiplication of Orders, genera, and

* Char. essent. Fructus uniformis: capsulæ glomerulum seminum minutissimorum sphæricum includentes.

† J. Ag. *Symbolæ* in Linnæa XV. p. 1 (1841). J. Ag. "Algæ maris Mediterranei et Adriatici observationes in diagnosin specierum, et dispositionem generum." Paris, 1842.

‡ "Phycologia Generalis, oder Anatomie, Physiologie, und Systemkunde der Tange." Leipsig, 1843.

species, many of them grouping together plants but little related, and others separating nearly allied species. Still, we are indebted to Kützing for reforming many of the old genera left untouched by earlier writers. I regret that in his more recent "*Species*"* he has pursued the deforming, rather than the reforming course, introducing innumerable false species, further subdividing genera, and even placing the same species in two or more widely separated genera.

I turn with pleasure to the work of a very different writer, Prof. J. G. Agardh, whose "*Species*,† *Genera*, *et Ordines Algarum*, now in course of publication, places him, for accurate analysis, careful description, original conception, and just views of system, far above any other author who has devoted his attention to the Algæ. In his former works he had sketched out the system which he has now more fully developed, has fortified by the examination of a very large number of species, and remodelled where alterations were necessary. The primary distribution into Orders is based on the structure and development of the *sporiferous nucleus*, which affords excellent discriminative characters. In the generic groups minute attention is paid to the anatomy of the frond, the position and partition of the tetraspores, the minor structure of the conceptacle, &c. The result, I trust, will be to place the systematic arrangement of the Algæ on a better and firmer foundation than it has yet stood. I have carefully gone over, with the dissecting knife and the microscope, much of Prof. Agardh's ground, and though I do not follow him in *all* the changes he has introduced, the points where we differ are few and unimportant, and open to future consideration. With the *principles* advocated in his system I fully coincide; I differ merely in a few cases where it seems to me, perhaps incorrectly, that natural affinity has been mistaken.

I take this opportunity to record the expression of my best thanks to those kind correspondents and friends in America who continue to supply me with specimens. Since the publication of the first part, I have received from Captain Nicholas Pike of Brooklyn an important contribution of Californian Algæ; from Dr. Blodgett of Key West a second interesting series of Floridan Algæ, containing some new forms; from Mr. Hooper a parcel from the North-eastern States, containing several not previously sent; and from Mr. Calverley, Algæ of New York Harbour, &c. These and other contributions will be found duly noted under each particular species in the body of the work; and should any novelties reach me before the publication of the third fasciculus, they shall be inserted in a supplement. Persons in America wishing to assist me with further specimens are requested to send parcels addressed to Dr. William H. Harvey, Trinity College, Dublin, to the care of Messrs. Abraham Bell and Son, 25, Park Row, New York; or to J. Van Voorst, Publisher, 1, Paternoster Row, London.

W. H. H.

Trin. Coll. Dublin,
November 24th, 1852.

* Species Algarum, auctore F. T. Kützing, Lipsiæ, 1849.

† "Species, Genera et Ordines Algarum, auctore J. G. Agardh." Lund, 1848-1852.

SYNOPSIS OF THE ORDERS OF RHODOSPERMEÆ.

Series 1. DESMIOSPERMEÆ, J. Ag. *Sporiferous nucleus* (either naked, immersed in the substance of the frond, or lodged in hollow conceptacles) consisting of tufted spore-threads attached to a basal, parietal, or central placenta. Single *spores* formed in each cell of the spore thread, or only in the terminal cell.

1. *Nucleus lodged in an external, ovate or spherical conceptacle.*

* *Placenta in the base of the hollow conceptacle. Spores pyriform or obconic, formed in the terminal cell of the spore threads.*

I. RHODOMELACEÆ. *Frond* articulate or furnished with an articulated polysiphonous axis; the surface areolated. *Spore-threads* simple. *Tetraspores* seriated in the ramuli, or in podlike receptacles.

II. LAURENCIACEÆ. *Frond* inarticulate, solid, or tubular and septate; the surface cells minute. *Spore-threads* simple or paniculate. *Tetraspores* irregularly scattered through the ramuli.

** *Placenta in the base of the hollow conceptacle. Spores roundish or elliptical, in moniliform strings; all the cells of the spore-thread gradually changed into spores.*

III. CORALLINACEÆ. *Frond* calcareous (its cells secreting carbonate of lime). *Spore-threads* separating at maturity into four spores.

IV. SPHÆROCOCCOIDEÆ. *Frond* cartilaginous or membranaceous. *Spore-threads* separating at maturity into many spores.

*** *Placenta axial, or suspended by filaments in the cavity of the external or half immersed conceptacles.*

V. GELIDIACEÆ. *Frond* inarticulate, cartilaginous or horny, opaque; the axis (at least) formed of elongated, confervoid filaments.

2. *Nucleus not lodged in a hollow conceptacle.*

* *Nuclei contained in wart-like excrescences.*

VI. SPONGIOCARPEÆ. *Frond* cartilaginous (cylindrical) almost wholly composed of confervoid filaments closely set in firm gelatine. *Nuclei* numerous in each wart, globose. *Spores* obconical, radiating from a central point.

VII. Squamarieæ. *Frond* lichenoid, horizontally expanded and rooting from the under surface, cartilaginous or membranaceous. *Spores* arranged in moniliform strings within the wart.

** *Nuclei immersed in the frond.*

VIII. Helminthocladieæ. *Frond* gelatinous, or gelatino-membranaceous (cylindrical) almost wholly composed of confervoid filaments set in loose gelatine. *Nuclei* spherical, formed of branching, moniliform spore threads issuing from a central point.

*** *Nuclei naked, involucrate.*

IX. Wrangeliaceæ. *Frond* filiform, monosiphonous, articulate or corticated with small cells. *Spores* pear-shaped, formed in the terminal cells of branching spore-threads.

Series 2. GONGYLOSPERMEÆ, J. Ag. *Sporiferous-nucleus* (either naked, immersed in the substance of the frond, or lodged in hollow conceptacles) subglobose, either simple or formed of many *nucleoli*. Numerous *spores* congregated without order within a hyaline, mucous or membranaceous periderm (or mother-cell).

* *Frond inarticulate, flat or cylindrical, compound.*

X. Rhodymeniaceæ. *Nucleus* lodged in globose *conceptacles ; spores* developed within the cells of moniliform, branching filaments issuing from a centre ; at length conglobated without order.

XI. Cryptonemiaceæ. *Nucleus* either lodged within a conceptacle or sunk in the frond ; *spores* developed within solitary or aggregated detached mother-cells ; at length conglobated without order.

** *Frond filiform, articulate, monosiphonous ; the articulations naked, or covered by a cortical layer of small cellules.*

XII. Spyridiaceæ. *Nucleus* lodged in an external, closed cellular pericarp, compound, consisting of many *nucleoli*, each formed by the evolution of paniculately branched spore threads ; *spores* at length conglobated without order.

XIII. Ceramiaceæ. *Nucleus* (a *favella*) naked or involucrate, simple ; containing *spores* conglobated without order within a hyaline membranous periderm (or mother cell), developed externally.

Order I.—RHODOMELACEÆ.

Harv. Man. Ed. 2, *p.* 75. *Rhodomeleæ, J. Ag. in Linn. XV. p.* 23. *Aly. Medit. p.* 116. *Endl. Gen. 3rd Suppl. p.* 44. *Harv. Ner. Austr. p.* 9 ; *J. Ag. Sp. Gen. and Ord. Algarum*, 2, *Syn. p.* xi. *Rytiphlææ, Dne. Class, p.* 62, *also part of Ceramieæ, Chondrieæ, Thamnophoreæ. and Anomalophylleæ, Dne. l. c. Dasyeæ, Polysiphonieæ, Chondrieæ* (*in part*), *Botryocarpeæ* (*in part*), *Amansieæ, Rytiphlæaceæ, Carpoblepharideæ* (*partly*) *and Claudieæ, Kütz. Phyc. Gen. p.* 414-451.

Diagnosis. Red or brown-red or purple seaweeds, with a leafy or filiform, areolated or articulated frond, composed of polygonal cells ; the inarticulate filiform species having an articulated axis composed of cells radiating round a central cell. *Sporiferous nucleus* contained in ovate or urceolate, perforate conceptacles ; *spores* pyriform, formed in the terminal cell of unbranched, tufted spore-threads radiating from a basal placenta. *Tetraspores* generally seriated, lodged either in distorted ramuli or in proper receptacles (*stichidia* or *sporophylla*).

Natural Character. *Root* either a simple disc, or accompanied by creeping fibres ; sometimes, in densely tufted filiform kinds, the primary fronds are prostrate, attached by lateral discs issuing along them at intervals, the secondary ones or branches erect. *Frond* very variable in habit, either leaflike or filiform ; or rarely formed into an anastomosing net-work. In the numerous forms found in various parts of the world all gradations between a perfectly developed, nerved, expanded leaf, and a capillary, articulated filament, finer than human hair, may be traced. In the flat, leaf-like species, the frond is sometimes (as in *Odonthalia*) thick, opaque, with minute surface cells, and either destitute of midrib or obsoletely ribbed ; sometimes (as in *Amansia*) it is delicately membranaceous, translucent, composed of regular twelve sided cells of equal length, arranged in transverse lines. Similar varieties occur in the cylindrical fronds, some of which are opaque, with small surface cells (*Alsidium, Acanthophora, Rhodomela*) ; others (as many *Polysiphoniæ*) are pellucidly articulate. This latter character, in several *Polysiphoniæ*, distinguishes all parts of the frond at all ages ; in others only obtains in the young frond, or in the younger branches and ramuli of older fronds. In such the articulations are gradually coated over by successive rows of smaller cells of unequal size and shape, and can only be discovered by making cross and longitudinal sections of the stems. A cross section being made, an articulated axis composed of several cells disposed like the spokes of a wheel round a central cell may be

detected in all the plants of this order, and affords a mark by which they may generally be recognised when not in fruit. The growing ends of the branches and ramuli are clothed with articulated, mostly dichotomous, monosiphonous hairs or *ramelli*, and sometimes the whole surface of the frond is thickly covered with them. In most cases they are deciduous, falling away soon after the point from which they spring becomes fully developed, but sometimes (as in *Dasya*) they are persistent, either remaining unchanged, or, (in the section *Stichocarpus*) eventually becoming polysiphonous and changing into ramuli.

Considerable uniformity prevails throughout the Order in the structure of the organs of fructification. The concepticle in all is of the form technically called *ceramidium*, that is, an ovate or urceolate hollow case, pierced by a terminal pore, and containing a tuft of spore-threads radiating from a basal, more or less elevated placenta. These conceptacles are formed at the ends or sides of the branches or ramuli, and are always transformations of shortened ramuli, or of the apices of branches. The *spores* are pear-shaped, tapering greatly to the base, and are formed singly from the terminal cells of the spore-threads. The *tetraspores* in all cases, so far as I am aware, are tripartite or unequally triradiate—three of the sporules only being visible at either face. They are never equally dispersed through the frond, and only in a few cases lodged in its unaltered ramuli. Most usually they are produced in little ovate or lanceolate, pod-like *receptacles* called *stichidia*, developed either from the midrib, the disc, or the margin of the leafy species ; or formed within the axils of the ramuli ; on the ends of the branches ; or even on the permanent hairs (as in *Dasya*) that clothe the surface. The distinctive generic characters often depend on the occurrence, the form, or the position of the *stichidia*. *Antheridia* have been found in several *Polysiphoniæ*, *Rhodomelæ*, *Dasyæ*, *&c.* They occur in the form of minute pod-like bodies, resembling the stichidia in shape, but much smaller, filled with exceedingly minute granular cells, and are usually of a pale yellow colour. They are mostly developments of the dichotomous hairs that crown the growing ends of the branches.

The order *Rhodomelaceæ*, though including within its limits many brilliant Algæ, contains a large proportion of darker and more soberly coloured species. It takes its name from one of the genera (*Rhodomela*) which is noted for changing from *red* to *black* during the process of drying, and very many others have similar properties. In *Odonthalia* the growing frond is blood red, while the dried is dark vinous purple. Many rosy or purplish leafy kinds change to dull brown. Brown again, of various depths and shades, is the proper colour of several *Polysiphoniæ ;* while others of that genus, though equally brown when dry, are a pure crimson or purple when growing. In so large a genus all hues of red, as may be supposed, are found, and are more or less lost or preserved in drying. The genus *Bostrychia* is remarkable for the depth and dulness of its purple colour, the only varieties being tinges of green, or of black or very dark brown. *Dasya* among the American genera shines out in greatest lustre, its soft fronds (as in *D. elegans*), clothed with a rich fleece of rosy purple ; a colour which is preserved or even heightened in the drying specimen.

None of the North America genera of this order are peculiar to the coasts of

this continent, and most are widely scattered. *Amansia*, *Alsidium*, *Acanthophora* and *Digenia* are either tropical or subtropical. *Odonthalia* is confined to the colder regions of the Atlantic and Pacific, and to the circum-polar Ocean. Perhaps its most southern limit in Europe is the Isle of Man (lat. 54° 20′), while in America it extends from the Arctic Coast at least to Halifax Harbour (lat. 44° 35′). *Rhodomela* is distributed in high northern and southern latitudes. There is a species (*R. concinna*, Hook. and Harv.) at the southern extremity of the New Zealand group, closely related to *R. floccosa* of our north-west coast; and others occur at the Falkland Islands and Cape Horn. *Rytiphlœa* is for the most part subtropical, but some of its species on the West Coast of Ireland reach to lat. 55°. *Polysiphonia* and *Dasya* may be said to be cosmopolitan. Of the former, between two and three hundred species have been described, probably a third too many. Several of these are found in the Eastern and Western Hemispheres, as well as in parallel climates north and south of the line. *P. fastigiata* is a very constant parasite on *Fucus nodosus*, wherever that grows. *P. nigrescens*, under one or other of its forms, prevails along the Atlantic shores; and *P. urceolata* and *formosa* are equally spread abroad. *Dasya elegans*, so abundant from Long Island Sound to Florida, has an equally wide range in Southern Europe; and a closely allied species, *D. villosa*, abounds in Van Dieman's Land. It is remarkable that *D. coccinea* so common on the shores of Europe has not yet been found in America, and that the North American species most nearly related to it has been brought from Puget's Sound, on the Pacific coast.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

* *Frond flat, pinnatifid.*

I. Amansia. Translucent, distinctly midribbed, membranaceous; the membrane formed of large, hexagonal cells, disposed in transverse rows.

II. Odonthalia. Opaque, obsoletely midribbed, thickish, composed of minute cells; those of the surface very minute, irregularly polygonal.

** *Frond filiform, inarticulate; the surface cells minute, of irregular form, and irregularly placed (not in transverse lines). Ramuli similar to the rest of the frond in structure.*

III. Alsidium. Laxly cellular; the *ramuli* short, spinelike, transversely striate. *Stichidia* axillary, tufted, fusiform.

IV. Acanthophora. Laxly cellular; the *ramuli* spinelike, opaque. *Stichidia* (formed in swollen ramuli) subglobose, thorny, sessile.

V. Chondria. Laxly cellular; the *ramuli* clubshaped, much attenuated at their insertion. *Tetraspores* lodged in the ramuli.

VI. Rhodomela. Densely, cellular; the *branches* and filiform *ramuli* opaque, not transversely striate. *Tetraspores* in the terminal, filiform ramuli.

VII. Rytiphlæa. Densely cellular with an articulated axis; the *ramuli* (at least) transversely striate or subarticulate. *Tetraspores* in the terminal, fusiform ramuli.

*** *Frond filiform, inarticulate, opaque. Ramuli articulate, longitudinally multistriate.*

VIII. Digenia. *Ramuli* subsimple, quadrifarious, densely imbricated.

**** *Frond filiform, either partially or wholly articulate, or tessellated* (i. e. *the surface cells coequal, arranged in transverse rows.*)

IX. Polysiphonia. *Frond*, at least the younger parts, obviously articulate; the articulations longitudinally two or many-striate.

X. Bostrychia. *Frond* tessellated with quadrate or oblong, purple cells.

***** *Frond filiform or compressed, inarticulate or subarticulate, beset with byssoid, single-tubed, articulate ramelli, which bear the fructification. Stichidia fusiform.*

XI. Dasya.

I. AMANSIA. Lamour.

Frond flat, delicately membranaceous, transversely striate, rosy purple, pinnatifid, midribbed; the membrane formed of oblong, hexagonal cells, of equal length, arranged in zones across the frond; the midrib slender, disappearing towards the apices. *Conceptacles* subglobose, sessile, marginal, containing a tuft of pear-shaped spores. *Stichidia* marginal, branched, containing a single or double row of tetraspores. *Antheridia* ovate, stipitate, borne on and about the inrolled apices of the lacinulæ.

A small genus of tropical or sub-tropical Algæ, resembling *Delesseria* in habit, but readily known, even without fruit, by the structure of the frond, which under a pocket lens appears to be finely striate transversely, and with a glass of greater magnifying power is seen to be composed of hexagonal cells of equal size. The membrane is thin, composed of two strata of cells, with thin walls, containing rosy endochrome.

1. Amansia *multifida*, Lamour.; stem vaguely branched, obsoletely winged, bearing numerous, irregularly placed, ovate, deeply bi-tri-pinnatifid fronds, proliferous from the midrib; laciniæ linear, with a very slender nerve; lacinulæ broadly subulate, their apices strongly inrolled. *Lamour. Bull. Phil.* 1809. *t.* 6. *Ag. Sp. Alg.* 1. *p.* 192. *J. Ag. in Linnæa. XV. p.* 26. *Odonthalia multifida*, *Endl.* 3*d. Suppl. p.* 47. *Epineuron multifidum*, *Kütz. Sp. Alg. p.* 848.

Hab. Abundantly cast up at Key West, *W. H. H.* &c. (v. v.)

Tufts much branched. *Stems* three to four inches long, cartilaginous, naked or winged with the remains of a membranous lamina, throwing out numerous, irregularly placed, leaf-like, secondary fronds, which are sometimes distant, sometimes densely crowded, when the plant becomes an intricate, globose mass of fronds. These secondary fronds are ovate or ovato-lanceolate in outline, either pinnatifid, bipinnatifid or tripinnatifid, delicately membranaceous, their main rachis traversed by a strong cartilaginous midrib, which gradually becomes thinner and fainter upwards; their pinnæ and pinnules marked by a very fine, depressed central line. The midribs of the larger branches are frequently proliferous. The apices of all the pinnulæ are strongly rolled inwards. I have not seen fruit of either kind; but what appear to be *antheridia* are very common (in February) crowding around the tips of all the laciniæ, the usual position in Algæ of this order: they are pedicellate, ovate, filled with minute grains. *Colour* a purplish pink, becoming browner in drying, and soon fading in fresh water. The substance is rather rigidly membranaceous, and in drying the plant does not adhere to paper.

Endlicher has strangely misunderstood the affinities of this plant, by placing it in *Odonthalia*, a genus with a very different structure.

II. ODONTHALIA. *Lyngb.*

Frond flat or nearly so, thickish, subopaque, distichously pinnatifid, obsoletely midribbed, the margin alternately toothed. *Structure* densely cellular; the surface cells very minute, polygonal, irregular in size and form. *Conceptacles* marginal, mostly axillary, pedicellate, ovate, wide-mouthed, containing a tuft of pear-shaped spores. *Stichidia* marginal, mostly axillary, stipitate, corymbose, lanceolate, containing a double row of tetraspores.

This group, separated from *Rhodomela* by Lyngbye, has been generally received by botanists, and by all but Endlicher, with nearly the same limitation. It differs from *Rhodomela* in the nearly flattened, two-edged, broadly linear frond, the middle portion of which is thickened into a more or less evident costa; and in the position of the fructification in axillary processes. The species have all been found in the

Northern Ocean, our American one being common to the north of Europe, and the other known species to the north-eastern shores of Asia.

1. *Odonthalia dentata*, Lyngb.; decompoundly pinnate; branches oblong, deeply pinnatifid or bipinnatifid ; laciniæ alternate, linear, sharply inciso-dentate toward their truncated extremities ; conceptacles and stichidia both clustered, axillary. *Harv. Phyc. Brit. t.* 34 (*colour incorrect*). *Kütz. Sp. Alg. p.* 846. *Fucus dentatus, Linn. Turn. Hist. t.* 13. *E. Bot. t.* 1241.

Hab. On rocks and stones in deep water. "Shores of America," *Gmelin.* Dredged in Halifax Harbour, *W. H. H.* Arctic Coast, *Mr. Seeman.* (v. v.)

Fronds 3-12 (in the Halifax specimens 4-5) inches long, decompoundly pinnatifid, the main divisions irregular, the secondary and subsequent regularly alternated, and erecto-patent. The main branches are evidently ribbed towards the base, where the marginal wing is narrow and frequently defective, and become less obviously ribbed, broader, flatter and thinner upwards. The secondary branches have an oblong or lanceolate or sometimes a flabelliform outline and are alternately pinnatifid ; the lowest laciniæ short, broadly subulate, tooth-like, the upper gradually larger and alternately inciso-dentate or again pinnatifid. In the specimens with flabelliform branches the upper laciniæ are proportionably much longer and more compound, all their divisions spreading. *Axils* very obtuse. *Apices* acute. The internal structure is dense, the substance composed of innumerable small, polygonal cells, closely packed together ; those of the surface exceedingly minute. *Fruit* (which I have not seen on American specimens) borne on little marginal processes either in or near the axils of the laciniæ ; both conceptacles and stichidia tufted. *Colour*, when growing, a clear, full, blood-red, becoming darker and changing either to vinous purple or to brown red ; when dried the tips sometimes assume a pinky tint.

The American specimens are smaller and narrower than the generality of those of British growth, but I can find no distinctive character, and have seen some from Orkney equally narrow. The *O. angustifolia*, Suhr, judging from a specimen in Herb. T. C. D., is a different species, seemingly the same as *O. Kamtchatica*, Rupr. The colour of the plate given in Phycologia Britannica, copied from a dried specimen, is very incorrect ; when growing, this plant is of a clear, translucent red.

III. ALSIDIUM, *Ag.*

Frond filiform or compressed, cartilaginous, pinnately or irregularly decompound, opaque, coated with small polygonal, irregularly placed cells ; *axis*

articulated, polysiphonous. *Ramuli* alternate, subulate, acute, transversely striate. *Conceptacles* inflated, solitary, with contracted and produced apertures, containing within a membranous pericarp a tuft of pear-shaped spores on simple funiculi, radiating from a basal placenta. *Tetraspores* tripartite, lodged in axillary, tufted, lanceolate receptacles (*stichidia*), irregularly seriated.

As revised by J. Agardh (Linnæa, vol. XV. p. 28.), this genus is nearly related to *Acanthophora* on the one hand, and to *Rhodomela* on the other. The species are all from the warmer parts of the ocean. I have seen only the *conceptacles* of *A. Seaforthii* and *A. Blodgettii;* and only the *stichidia* of *A. triangulare.*

1. Alsidium *triangulare*, J. Ag.; frond triquetrous, between dichotomous and pinnate, much branched; branches alternate or secund, closely set throughout with minute, trifarious, bifid, trifid or multifid ramuli; stichidia axillary, tufted. *J. Ag. in Linnæa XV. p.* 28. *Bryothamnion triangulare, Kütz. Sp. Alg. p.* 842. *Physcophora triangularis, Kütz. Phyc. Gen. p.* 434. *t.* 57. *fig.* 1. *Thamnophora triangularis, Ag. Syst. Alg. p.* 240. (Tab. XIII. A.)

Hab. Abundantly thrown up at Key West. (A common West Indian species). (v. v.)

Frond 6-12 inches long or more, excessively branched. *Stem* cartilaginous, cylindrical below, where it is frequently two lines in diameter, gradually becoming narrower and more compressed upwards, forking repeatedly and then irregularly divided. *Branches* scattered, triangular, with a flabelliform outline, much divided; the lesser branches alternate or secund, having shorter branchlets toward the apices. All the younger parts of the frond are set, at distances of a line or two, with minute, trifarious, mostly three pronged ramuli, not a line in length: these, as well as the younger part of the branches, appear transversely striate when examined with a pocket lens. *Conceptacles* I have not seen. *Stichidia* densely tufted in the axils of the trifid ramuli, distorted, more or less fusiform, tapering to a point, each containing three or four large tetraspores in an imperfect line. A cross section of the frond shows a small axial cell surrounded by eight *primary* cells (or *siphons*), outside which are several rows of irregularly polygonal cells, which diminish in size to the circumference. The surface cellules are very minute, so that the branches appear opaque and inarticulate. *Colour* when fresh a clear purplish pink, soon fading in the sun, and becoming reddish brown in the herbarium. *Substance* cartilaginous, very tough, and not in the least adhering to paper in drying.

Plate XIII. A.—*Fig.* 1. A small plant of Alsidium *triangulare;* the *natural* size. *Fig.* 2, apex of a branch with three-pronged ramuli; *fig.* 3, tuft of *stichidia* containing *tetraspores*, removed from the axil of a ramulus; *fig.* 4, a transverse section of the frond;—the latter figures more or less highly *magnified.*

2. Alsidium *Blodgettii*, Harv.; frond sub-compressed below, terete above, decompound pinnate ; pinnæ alternate, patent, close, virgate, the lowest very long, set with short, setaceous, spinous-toothed, alternate, distichous ramuli; upper branches short and sub-simple ; conceptacles pedicellate, inflated, urceolate, variously placed on the ramuli. (Tab. XV. B.)

Hab. At Key West, *Dr. Blodgett*, (No. 73.) St. Marks, Florida, *Mr. Hooper*. Apalachicola, *Capt. Pike* (v. s. in Herb. T. C. D.).

Frond of unknown length, probably a foot or more. *Branches* pinnate or bipinnate ; the lowermost pinnæ long, simple or again pinnate ; the upper much shorter or altogether abortive, so that the apices of the branches project, like long tails, beyond the bushy part of the frond. All the divisions are very patent, the primary and secondary ones almost horizontal. The secondary (or pinnæ) are distichous, about two lines apart, and are from two to three inches in length, about the thickness of hog's bristle, gradually tapering to a point. Near the base they are generally bare of ramuli, or are merely toothed, but for the greater portion of their length are set with distichous bristle-shaped ramuli, a line apart and two or three lines long. These ramuli are regularly spinoso-dentate. The *conceptacles*, which are abundant on some of my specimens, are as large as poppy-seed, inflated, thin walled, with a prominent, contracted orifice, and contain a very large tuft of pear-shaped spores. They are placed either just above the axils of the ramuli, or at their apex, or along their margin, and appear to be formed by a metamorphosis of the spinous teeth which regularly alternate, in distichous order, along all the branches and ramuli. A cross section of the stem shews a central cavity surrounded by five primary cells, outside which several large cells are interposed between the primaries and the peripheric cells. The *colour* appears to have been a clear, full red, fading to yellowish on exposure. The substance is cartilaginous, but somewhat tender, and the plant, in drying, adheres pretty strongly to paper.

For a knowledge of this very interesting plant, I am indebted to my friend Dr. Blodgett of Key West, whose name I have therefore bestowed upon it. At the time the figure and description were made, I had seen but a single specimen ; but have since received numerous and beautiful specimens from Dr. Blodgett, in all important respects agreeing with that first found. Captain Pike and Mr. Hooper have communicated, from the mainland of Florida, less perfectly preserved specimens; which, notwithstanding some minor differences, I refer without hesitation to this species. I think it can hardly be doubted to belong to the same natural genus as *A. Seaforthii*, though abundantly distinct from that species.

Plate XV. B. *Fig.* 1. A branch of Alsidium *Blodgettii*, the *natural* size. *Fig.* 2, apex of a branch, with toothed ramuli and conceptacles ; *fig.* 3, a conceptacle and ramulus removed ; *fig.* 4, spores from the conceptacle ; *fig.* 5, transverse section of the stem ; the latter figures more or less highly *magnified*.

IV. ACANTHOPHORA. *Lamour.*

Frond filiform, cartilaginous, irregularly decompound, opaque, coated with small, polygonal, irregularly placed cellules; *axis* articulated, polysiphonous. *Ramuli* densely crowded on all sides of the branches, short, spinelike, acute. *Conceptacles* urnshaped, perforate, borne on the ramuli, containing within a cellular pericarp a tuft of pear-shaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* tripartite, lodged in globose receptacles (*stichidia*) formed in swollen ramuli.

A small genus composed of a few tropical or subtropical species, the distinctive characters of which are not well defined. They become very dark, often nearly black, in drying, and are readily known by their spinelike ramuli. The natural habit is nearly the same as in *Alsidium*, but the stichidia have a different origin, being here formed out of the very substance of the ordinary ramuli, and not a special axillary growth.

1. Acanthophora *Thierii*, Lamour.; irregularly pinnate or bi-pinnate, or not much branched; branches long, subsimple, tapering, beset throughout with quaquaversal, subulate ramuli, which are densely clothed with simple or trifid spines. *Lam. Ess. p.* 44. *Kütz. Sp. Alg. p.* 858. *Fucus acanthophorus*, *Lamour. Diss. t.* 30 & 31. *f.* 1. *Turn. Hist. t.* 32. *A. militaris*, *Lam. A. muscoides*, *Grev.* (Tab. XIV. A.)

Hab. "Shores of North America," *Lamouroux.* Key West, *W.H.H.* (No. 4). Key West and Conch Key, *Prof. M. Tuomey* (41, 42, 43). (v. v.)

Fronds 3-6 inches long, half a line in diameter, alternately or irregularly branched; branches sometimes closely placed, sometimes distant, erecto-patent, long, little divided, flexuous, sometimes having a few secondary branches above, beset throughout at distances of a line apart with quaquaversal, very patent, short ramuli. *Ramuli* one or two lines long, densely bristled with short, simple or trifid, broadly subulate, patent or reflexed spines. *Conceptacles* urn-shaped, with a contracted orifice, seated on the sides or tip of the ramulus, and formed out of one of its spines. A cross section of the frond shows five large primary cells surrounding a small central cavity, and a wide border of smaller irregularly angular cells, gradually diminishing in size towards the periphery, which is formed of very minute cells. No outward appearance of articulation, or transverse striæ. *Colour*, a dark, lurid purple, becoming brown or even black in drying. *Substance* cartilaginous, firm. By pressure the plant may be made to adhere partially to paper in drying.

I regret that I had not noticed the conceptacles, which I find on one of Prof. Tuomey's specimens, in time to introduce a figure of them into the plate.

My specimens agree very fairly with the figure and description of Lamouroux

quoted above, except that Lamouroux represents the spiniferous ramuli shorter than I find them. He received the plant on which he founds his species from "North America," but was uninformed of the exact locality where it was gathered. I have little hesitation, therefore, in adopting his specific name. Nor do I hesitate to refer the *A. muscoides*, Grev., typified by Turner's plate 32, nor the *A. militaris*, Lamour., to the same species; for though my specimens from Key West are much less copiously branched than the figures given by the authors just named, yet I find such a series of connecting links in numerous specimens from St. Croix, which I owe to Miss Dix, and specimens from Chili collected by Baron de Selding, that I cannot point out any valid difference. Some are scarcely branched, others closely pinnate or bi-pinnate, and both forms sometimes occur in the same tuft. I am not alone in this opinion, doubts of the validity of *A. muscoides* being held by Dr. Montagne, (*Nat Hist. Cuba, p.* 43,) who has kindly sent me a specimen of his plant, and it closely agrees with some of my Key West specimens.

Plate XIV. A. *Fig.* 1, Frond of Acanthophora *Thierii;* the *natural* size. *Fig.* 2, a spiniferous ramulus; *fig.* 3, cross section of the stem; the latter figures more or less *magnified.*

2. Acanthophora *Delilei*, Lamour.; much branched and bushy, decompoundly pinnate or irregularly divided; branches beset with long and short, sub-spiniferous ramuli, and with solitary, distant, short spines. *Lamour. Ess. p.* 44; *Kütz. Sp. Alg.*, 858; *Phyc. Gen. t.* 52, *f.* 4; *Fucus naiadiformis, Delile, Egypt. t.* 56, *f.* 1.

Hab. At Sand Key and Key West, *W. H. H.* (No. 3.) (v. v.)

Fronds in large tufts, 4—6 inches long, one-third of a line in diameter, excessively branched from the base. *Branches* alternate or secund, rarely opposite, spreading, simple below, beset with secondary branches above. These secondary branches are often again pinnate or bipinnated with lesser ramuli of unequal lengths. *Ramuli* either naked, or having a few distant, horizontal spines, or regularly beset with alternate spines. The larger branches also are furnished with scattered, simple, solitary spines. *Substance* cartilaginous. *Colour* dull purple, or brownish, becoming very dark when dry, in which state the plant imperfectly adheres to paper.

This is a more slender and much more diffusely branched plant than the preceding, from which it is technically distinguished chiefly by the scattered solitary spines, found on all the branches in greater or less plenty. Our specimens agree in most respects with specimens from the Mediterranean, but I am not without doubts, whether the differences indicated between this plant and *A. Thierii* are valid.

V. CHONDRIA. *J. Ag. ref.*

Fronds filiform, cartilaginous, pinnately decompound, opaque, coated with small polygonal, irregularly placed cells. *Axis* articulated, polysiphonous. *Ramuli* club-shaped, very much constricted at their insertion, obtuse or sub-acute, transversely striolate. *Conceptacles* ovate, perforate, sessile or pedicellate on the ramuli, containing, within a cellular pericarp, a tuft of pear-shaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* tripartite, crowded irregularly in the club-shaped ramuli, formed from the endochrome of the radiant cells.

Frond of a cartilaginous or subgelatinous substance, soon decomposing in fresh water, and generally closely adhering to paper in drying, filiform, more or less regularly pinnately decompound, but not strictly distichous. *Branches*, and their subsequent decompositions, simple, virgate, attenuated at the base and apex, set with more or less abundant lateral, scattered, spirally inserted simple ramuli, which are always very much constricted at the base, and either abruptly truncate or attenuate at the apex. The surface of the frond is composed of small irregular oblong cells, through which the internal articulated axis is rarely visible, except in the ultimate ramuli of some species. This *axis* is formed of four or five large oblong cells of equal length, disposed in a radiant manner round a central cell. Some species are rosy purple, staining fresh water carmine ; others in steeping give out a brown fluid of offensive odour, and stain paper a fulvous brown ; others are dark purple, or tinged with green. *Conceptacles* generally on the sides of the ramuli, mostly ovate and subsessile. *Tetraspores* lodged within the axial cells of the ramuli, one or more in each cell, large, irregularly crowded near the extremities.

A large genus, the species of which until recently have been arranged among the *Laurenciæ*, from which position Prof. J. Agardh has very properly separated them. Their agreement with *Laurencia* (typified by *L. pinnatifida* and its allies) is more in external habit than in structural character. They differ especially in the articulated polysiphonous axis, a character by which they are associated with the *Rhodomelaceæ*. Besides the North American species described below, I possess some imperfect specimens from Key West, which I have not been able to refer to their proper place ; and probably other new species may remain to reward a diligent search on the shores of the Southern States.

1. Chondria *sedifolia ;* frond alternately much branched ; branches patent, decompound, beset with short, spindleshaped, scattered or tufted ramuli much contracted at the base, and sub-acute or obtuse at the apex ; conceptacles ovate, sessile on the ramuli. (Tab. XVIII. G.)

Hab. Key West, *Mr. Binney, W. H. H., Dr. Blodgett,* (33, 34, &c.) *Prof. Tuomey,* (45, 52, &c.) (v. v.)

Frond 4-6 inches long, as thick as sparrow's quill, much branched, either with a leading stem pinnated or bipinnated with lateral, closely set, patent branches ; or alternately or irregularly multifid, the branches straight or curved, spreading in all directions. *Branches* once or twice compound, sometimes nearly naked, but oftener densely clothed with ramuli about a line in length, and very much constricted at the base, acute or obtuse at the apex. *Conceptacles* ovate, wide-mouthed, sessile on the ramuli. *Tetraspores* in the ramuli of distinct plants. *Colour* a dark reddish-brown, fading to yellow. *Substance* cartilaginous, less apt to decompose, than others of the genus. In drying it adheres to paper.

Perhaps only a variety of *Ch. dasyphylla*, but the habit is very peculiar.

Plate XVIII. G. *Fig.* 1. Branch of Chondria *sedifolia*, the *natural* size. *Fig.* 2, small portion, with ramuli and conceptacles, *magnified.*

2. Chondria *dasyphylla*, Ag. ; frond robust, elongate, alternately much branched; branches simple or decompound, beset with short, clubshaped or topshaped, blunt ramuli, much constricted at the base. *Ag. syst. Alg. p.* 205. *Laurencia dasyphylla, Grev.—Harv. Phyc. Brit. t.* 152. *Kütz. Sp. Alg. p.* 853. *Fucus dasyphyllus, Turn. Hist. t.* 22. *E. Bot. t.* 847.

Hab. On Algæ, &c. between tide marks. Annual. Newport, *Mr. Olney.* Peconic Bay, *Prof. Bailey, and W. H. H.* Key West, *W. H. H., Dr. Blodgett,* (23, 24) (v. v.)

Fronds tufted, 6-12 inches long, as thick as a crow quill, cylindrical, not much attenuated upwards. *Stem* rarely parted towards the base into several branches, generally undivided, set with lateral branches which are either simple or furnished with a second or third series. *Ramuli* a quarter to half an inch long, blunt, much constricted at the base. *Colour* a purple brown, becoming duller in drying. The substance of the growing plant is firm and cartilaginous, but soon becomes flaccid in the air, and if left a short time in fresh water the ramuli fall off and the frond rapidly decomposes, tinging the water dark brown. It closely adheres to paper in drying.

The North American specimens are a little different from the common European form, most of the ramuli, though blunt, being rounded, not truncate at the top. In one of my Greenport specimens, however, I find the ramuli as abruptly truncate as in the normal condition of the species.

3. Chondria *Baileyana*, Mont. ; frond setaceous, much branched below ; branches long and virgate, erect, subsimple, beset throughout with scattered, simple or pinnated, slender, curved ramuli which are greatly attenuated to the base and obtuse at the apex ; conceptacles pedicellate, on the ramuli. *Laurencia Baileyana, Mont. in An.* sc. nat. 3rd Ser. Vol. 2, p. 63. (Tab. XVIII. A.) var. *β.* with a leading stem closely pinnated with lateral branches.

Hab. On Algæ, &c. near low water mark. Annual. A common plant in Long Island Sound. Newport, *Prof. Bailey.* New Bedford, *Dr. Roche.* Little Compton, &c. *Mr. Olney.* Seaconnot, *Mr. Congdon.* New York Harbour, *Prof. Bailey, Mr. Hooper, and Mr. Calverley, &c.* (v. v.)

Fronds densely tufted, 6-8 inches long, as thick as hog's bristle, generally with a short stem soon dividing into several long, rodlike branches. *Branches* erect, 4-5 inches long, simple or once or twice compound, set at short intervals with slender ramuli, which at first are simple, and afterwards pinnulated or even bipinnulated with similar smaller ramuli. The ramuli spread to every side and are very generally curved, from a quarter to half an inch long, much attenuated to the base, somewhat narrowed upwards, but ending in a blunted, roundish point The *conceptacles* are ovate, on little stalks rising from the sides of the ramuli ; and the *tetraspores* are generally confined to the apices. *Colour*, when growing in deep water, a fine brownish purple. In fresh water it soon gives out a rose-coloured fluid which stains the paper on which the specimen is displayed, and to which it closely adheres in drying. *Substance* soft and tender.

This plant varies very much in ramification. The specimens described by Dr. Montagne appear to have been but little branched, the branches springing near the base. I have seen such, but they do not convey an adequate idea of the ordinary form, which is usually much more decompound. Some specimens have a leading, stem closely pinnated with branches ; and in others the branches are bipinnate with very densely set, plumose ramuli. As a species it is almost exactly intermediate between *Ch. dasyphylla* and *Ch. tenuissima*, having the slender habit of the latter, and ramuli almost as blunt as in the former, though much more attenuated.

Plate XVIII. A. *Fig.* 1. Chondria *Baileyana*, the *natural* size. *Fig.* 2, portion of a branch, with ramuli and *tetrasporic* fruit ; *fig.* 3, apex with tetraspores ; *fig.* 4, a tetraspore ; *fig.* 5, ramulus with conceptacles ; *fig.* 6, a conceptacle ; all more or less highly *magnified.*

4. Chondria *tenuissima*, Ag. ; frond slender, terete, irregularly divided ; branches long and virgate, clothed with very slender, setaceous ramuli, which taper much to the base and the acute apex. *Ag. Syst. Alg. p.* 205. *Laurencia tenuissima, Grev.— Harv. Phyc. Brit. t.* 198. *Alsidium tenuissimum, Kütz. Sp. Alg. p.* 843. *Fucus tenuissimus, Turn. Hist. t.* 100. *E. Bot. t.* 1882. (Tab. XVIII. F.)

Hab. Boston Bay, and New Haven, *Dr. Durkee.* Hell Gate, New York, *Mr. Hooper*, (v. v.)

Fronds 4-6 inches long, about twice as thick as hog's bristle, with an undivided stem set with lateral, mostly alternate spreading branches. *Branches* simple or pinnated with a second series of similar branches, and furnished throughout with

more or less abundant setaceous ramuli from a quarter to half an inch in length and mostly simple. *Ramuli* very narrow, fusiform, tapering much to the base and to the acute apex. *Conceptacles* ovate, on the ramuli, mostly pedicellate. I have not seen tetraspores on American specimens. *Substance* cartilaginous, tender. In drying the plant adheres to paper.

Apparently rare on the American coast. The few specimens which I have seen have the essential characters of the European form, but are less luxuriant.

Plate XVIII. F. Fig. 1, branch of Chondria *tenuissima;* the natural size. Fig. 2, small portion with ramuli, *magnified.*

5. Chondria *littoralis ;* frond robust, elongate, subdichotomous or irregularly much branched; branches flexuous, attenuated, with rounded axils; ramuli scattered or crowded, fusiform, attenuated to the base and apex, simple or pinnulated, acute. Var. β. ramuli very densely crowded, pinnate and bi-pinnate; conceptacles ovate, sessile, near the tips of the ramuli.

Hab. On the Florida Keys. Abundant at Key West, near high-water mark. *W. H. H., Prof. Tuomey,* (58, 59, &c.) (v. v.)

Tufts very large and dense, often spreading over a considerable space. *Fronds* twelve inches long or more, as thick as crow's quill or somewhat thicker below, attenuated upwards, much and very irregularly branched ; the main stem once, twice or many times forked, the arms spreading widely. Sometimes two, sometimes three branches spring from each fork. *Branches* of unequal length, erect, flexuous, tapering to the apex, either nearly naked or more or less abundantly furnished with slender ramuli. The older parts are generally denuded, but in var. β. all the branches are densely beset with pinnato-multifid ramuli. *Ramuli* a quarter to half an inch long, lineari-fusiform, much attenuated at the base, curved, tapering to an acute or subacute point. *Conceptacles* ovate, sessile. *Colour* a pale yellowish fawn, with a reddish tinge. *Substance* cartilaginous, soon decomposing in fresh water. In drying it stains the paper brownish yellow.

In mere technical character this approaches *Ch. tenuissima*, but is a much larger, coarser and less regularly branched species. It abounds along the shore at Key West, after growing quite up to high water limit. It is one of the least ornamental of the genus.

6. Chondria *atropurpurea ;* frond robust, dark coloured, inordinately much branched ; branches patent, the secondary ones, as well as the scattered ramuli tapering to the base and attenuated to an acute point; conceptacles unknown. (Tab. XVIII. E.)

Hab. Sullivan's Island, Charleston, *Prof. L. R. Gibbes, W. H. H.* Apalachichola, *Mr. Hooper,* (97.) (v. v.)

Fronds tufted, in our specimens about four inches high, but the full grown plant is probably much taller, as thick as sparrow's quill or somewhat thicker, irregularly branched, the branches alternate or unilateral, spreading at wide angles or nearly at right angles to the point from which they spring, curving upwards and bearing several irregularly placed, erect, secondary branches. These latter are narrow-fusiform, one or two inches long, much constricted at the base, and tapering to an acute point. They are sometimes naked, but more commonly set with small ramuli of similar shape and one to three lines in length. The colour is a dark, blackish purple. The substance is firmly cartilaginous, and in drying the plant adheres to paper.

Our specimens, gathered early in January, are evidently immature, and therefore this species must remain somewhat doubtfully characterised. I think it however essentially different from any of those described in this memoir. Its nearest affinity seems to be with *Ch. capensis* (*Harv. Ner. Austr. t.* 31.) but in the absence of more certain evidence, it would be premature to unite them. I find among Dr. Coulter's Californian plants a *Chondria* which agrees in most respects with our Charleston specimens, and may belong to the same species. But I am unwilling to confuse the subject by quoting it under this species, or unnecessarily to add to the number of species by describing it as different. I hope Prof. L. R. Gibbes, by visiting the above locality a month or two later in the season, may succeed in finding more complete specimens than we have yet procured. Among Dr. Blodgett's Key West specimens are two, (No. 27 and 29) possibly referable to our *Ch. atropurpurea*, but, for the reason just given, I forbear quoting them under it. One has large, ovate, stalked conceptacles; the other tetraspores in the ramuli.

Plate XVIII. E. Fig. 1. Branch of CHONDRIA *atropurpurea*, the *natural* size. Fig. 2, small portion with ramuli, slightly *magnified.* Fig. 3. longitudinal section of the stem, more highly *magnified.*

V. RHODOMELA. Ag.

Frond filiform or subcompressed, cartilaginous, decompound-pinnate, opaque, densely cellular within, coated with minute, polygonal, irregularly placed cells; *axis* articulate, polysiphonous. *Ramuli* filiform. *Conceptacles* ovate, pedicellate or sessile, containing within a membranous pericarp a tuft of pear-shaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* immersed in the swollen, ultimate divisions of the branches, rarely in proper stichidia.

The species included in this group are natives of the cooler portion of the temperate zone, both of the northern and southern hemispheres. They are naturally

associated together by a common habit, but it is not easy to point out a clear generic character which will separate them from *Rytiphlæa* and from the more opaque species of *Polysiphonia*, from which genera they chiefly differ in their denser cellular substance and the absence of all appearance of articulation in any part, even the youngest, of the frond. In a young state, or when the frond is in active extension, the apices of the branches are clothed with dichotomous fibrils, resembling in structure, and no doubt analogous to, the ramelli of *Dasya;* but these fibrils are fugacious, as in *Polysiphonia*, &c.

Of the North American species, three belong to the Pacific, and three to the Atlantic Coast.

1. Rhodomela *Larix*, Ag.; frond robust, terete, alternately branched; branches long, subsimple, densely clothed with quaquaversal, tufted, inflexed, subulate ramuli; stichidia attenuate, among the clustered ramuli. *Ag. sp. Alg.* 1, *p.* 376. *Lophura Larix*, *Kütz. Sp. Alg. p.* 850. *Fucus Larix*, *Turn. Hist. tab.* 207.

Hab. Pacific Coast from the shores of the Arctic Sea (*Seeman*) to Monterey, abundantly. *Coulter! Tolmie! Wilkes! Garry!* &c. Discovered at Nootka Sound by *A. Menzies, Esq.* (v. s. in Herb. T. C. D.)

Frond 6-14 inches long or more, terete, the thickness of a crowquill, undivided to the height of two or three inches, thence upwards much branched. *Branches* alternate, 4-6 inches long, simple, or bearing in the upper half several secondary branches, and, occasionally, in luxuriant specimens, a third set. The lower part of the stem is commonly bare, or clothed with the broken stumps of old branches, but all the younger parts of the frond are densely covered on all sides with spirally disposed tufts of short, inflexed, subulate ramuli, two or three lines in length. These ramuli spring from very short or abortive lateral branchlets on which they are inserted one above the other, but so near together as to appear fascicled. Sometimes the axis of the fascicle is a little lengthened and then the ramuli appear scattered, but are still very closely placed. Judging from dried specimens the ramuli are laterally compressed, shaped like the blade of a knife. The false *stichidia* are formed from the inner or upper ramuli of the fascicles, and are generally found on such specimens as have the axis of the fascicles a little lengthened. They are more slender than ordinary ramuli, and of greater length, but scarcely less opaque: the *tetraspores* are small. *Conceptacles* ovate, crowding at the base of the tufted ramuli, being formed from the inner ones of the fascicles. *Substance* coarse, between coriaceous and cartilaginous. In drying the plant becomes almost black, and does not adhere to paper.

2. Rhodomela *floccosa*, Ag.; stem filiform below, compressed above, alternately branched; branches spreading, subsimple, pinnated throughout with short, alternate, distichous, fasciculato-multifid, compressed ramuli; stichidia lanceolate, formed

from the ramuli ; conceptacles ovate, terminal. *Ag. Sp. Alg.* 1, *p.* 376. *Lophura floccosa*, *Kütz. Sp. Alg. p.* 850. *Fucus floccosus*, *Turn. t.* 8, *Esper t.* 100.

Hab. Pacific coast at Port Trinidad, lat. 41° 12′, *Mr. Menzies.* Sitcha, *Ruprecht !* Nootka Sound, *Barclay !* Monterey, *Dr. Coulter.* Off the west coast, lat. 32°, *Lieut. Wood*, H.M.S. "Pandora." (v. s. in herb. T. C. D.)

Frond 5–10 inches long, filiform below, soon compressed and becoming more compressed toward the extremity, twice as thick as hogs' bristle, with a leading stem which is once or twice pinnated in its upper half with lateral, alternate, erecto-patent branches. *Branches* distichous, subsimple, sometimes with a second series from their upper half, regularly beset throughout with alternate, distichous, multifid branchlets, one or two lines in length. These branchlets are alternately decompound, their lowest ramulus simple and subulate, those over it again and again compounded ; each ultimate division of the frond slender, subulate, acute, incurved. *Conceptacles* ovate, usually terminating the compound multifid branchlets, being formed from their last developed ramuli. *Stichidia* lanceolate, apiculate, formed of the inner or upper ramuli of the branchlet, and containing a double row of tetraspores. *Colour* in the dry state dark brown or black ; probably red brown when recent. *Substance* rigid. It does not adhere to paper in drying.

A smaller and slenderer plant than the preceding, with distichous ramification and a more developed axis to the multifid branchlets. It is closely related to *R. subfusca*, but the habit is peculiar, and the compression of the frond an obvious character.

3. Rhodomela *pilulifera*, Grev. ; frond robust, cartilaginous, terete or compressed, decompound ; branches distichous, alternate, distant, not much divided ; ramuli few, scattered, subulate, the lowest short and spinelike, the upper somewhat filiform ; conceptacles very large, globose, terminal or sessile near the ends of the branches. *Grev. Hist. Alg. Brit. p.* li. *Sphærococcus pilulifer. Ag. syst. p.* 236. *Fucus pilulifer or globulifer*, *Turn. Hist. t.* 236.

Hab. Nootka Sound, 1778, *A. Menzies, Esq.* (v. s. in Herb. Menzies.)

Frond 6 inches long or more, twice or thrice as thick as hog's bristle, irregularly decompound, but not much branched ; branches distant, alternately divided twice or thrice, the penultimate divisions somewhat virgate, either naked or with a few distant, short, spinelike, alternate, distichous ramuli below, and several larger and more filiform subulate ramuli in their upper half. Branches and ramuli compressed when dry, but becoming nearly terete when moistened. *Substance* very opaque and rigid. Structure as in *R. subfusca*. *Conceptacles* larger than poppy-seed, spherical, terminating the branches or sessile near the ends of the ramuli. *Colour* very dark.

Turner rightly refers this species to the neighbourhood of *R. subfusca*. Indeed, conceptacles apart, it is not easy to distinguish it from the battered, winter condi-

tion of that variable plant. Turner describes the frond much more compressed than I find it in the specimen preserved in Mr. Menzies' Herbarium. A cross section after expansion shows the branches to be nearly cylindrical.

4. Rhodomela *subfusca*, Ag.; frond filiform, much branched; the branches irregularly divided, clothed with pinnated branchlets, and subulate, simple, scattered or subfasciculate ramuli; pinnules subulate, terete; conceptacles subsessile; tetraspores in the somewhat swollen, (but neither moniliform nor attenuated) terminal ramuli (in summer), or in proper branching stichidia issuing irregularly from old stems (in winter.) *Ag. Sp. Alg. vol.* 1. *p.* 378. *Harv. Phyc. Brit. t.* 264. *Lophura cymosa*, *Kütz. Sp. Alg. p.* 850.

Hab. On rocks and stones near low water mark. Halifax, *W. H. H.;* Boston, *Dr. Durkee!* Lynn, *Mrs. Estes!* Boar's Head, New Hampshire, *Capt. N. Pike!* Newport, Rhode Island, *Prof. J. W. Bailey!* Staten Island, New York. (v. v.)

Fronds tufted, 6-12 inches long, quarter to half a line in diameter at base, filiform, attenuated upwards, much branched and bushy. *Branches* alternate, distichous or subspirally inserted, the secondary ones decompound, about bipinnate; tertiary branches furnished in the lower half with simple, alternate, sub-distant, subulate ramuli; above furnished with more compound, pinnulate or multifid ramuli, which are densely crowded about the ends of the branches. *Conceptacles* ovate, nearly sessile (not seen on American specimens). *Tetraspores* contained in the terminal, subulate or slightly fusiform, terminal ramuli, solitary or in pairs, not wider than the places where they occur. *Colour*, a dark, brownish red, becoming much darker in drying. *Substance* cartilaginous, somewhat rigid. In drying, the plant adheres, under pressure, to paper, but not with much force.

In winter the smaller branches fall away, leaving a few naked stems, and at that season tetraspores are frequently found in little, lateral, accessory stichidia, emitted without order by the broken branches. In spring, these denuded plants put forth a profusion of pinnato-multifid branches, being much more bushy than plants of the first season.

My Halifax specimens are very robust. The rest are of the ordinary form so common in Europe.

5. Rhodomela *gracilis*, Kütz.; frond flaccid, ultra-setaceous below, soon divided and then excessively branched and bushy, decompound pinnate; the branches setaceous below, capillary above, repeatedly divided alternately; penultimate ramuli distant, dichotomo-multifid above the middle, attenuate; conceptacles pedicellate, somewhat racemose; tetraspores in the attenuated, moniliform, terminal ramuli. *Lophura gracilis*, *Kütz. Sp. Alg. p.* 850. *Rhodomela subfusca (in part) Ag. l. c. supra. Lyngb. Hyd. Dan. t.* 10. *fig. B. C.* Tab. XIII. C.

Hab. Prince Edward's Island, *Dr. Jeans.* Halifax, *W. H. H.* Boston Harbour, *Mr. G. B. Emerson.* Plymouth, Massachussetts, *Prof. J. W. Bailey.* (v. v.)

Frond from four to ten or twelve inches long, divided a little above the base into a multitude of slender stems, about twice the diameter of hog's bristle below, but soon attenuated and reduced to a hair-like fineness. *Stems* many times decompound in an alternate or secund order, spuriously dichotomous by the occasional suppression of a branch ; the axils distant, rounded. Secondary *branches* long, and about bipinnate ; the pinnæ distant, simple below, alternately or subdichotomously multifid beyond the middle. Ultimate *ramuli* capillary, very much attenuated, and tipped with a pencil of slender, dichotomous fibrils. Sometimes the ramuli are densely crowded at the ends of the branches, sometimes not so. *Conceptacles* broadly ovate, on short stalks, racemose along the terminal ramuli, very abundant on fertile plants. *Tetraspores* in pairs, immersed in the slender ultimate ramuli which then become beaded by the bulging out of the tetraspores, which are much broader than the places where they occur. *Colour* a brownish red, becoming dark brown in drying. *Substance* very soft and lubricous. In drying, this plant adheres closely to paper.

Allied to *R. subfusca*, with which Agardh unites it, but differing in being of very much softer substance, more bushy and decompound, and especially in the large size of the tetraspores, causing the beaded appearance of the fertile ramuli. I have very numerous specimens from Dr. Jeans, presenting several varieties. Some to the naked eye have the aspect of *Polysiphonia Brodiæi*, for which they may readily be mistaken without microscopic examination ; others resemble *Pol. violacea* outwardly. All adhere with great closeness to paper, and must have been very lubricous when fresh.

Plate XIII. C. *Fig.* 1. Upper portion of a dichotomo-multifid branchlet of Rhodomela *gracilis* with tetrasporic fruit ; *fig.* 2, moniliform apex of one of the ultimate ramuli of the same ; *fig.* 3, a tetraspore ; *fig.* 4, a conceptacle ; *fig.* 5, transverse section of a branch ; all the figures more or less *magnified.*

6. Rhodomela *Rochei ;* frond setaceous, flaccid, rosy red, terete, decompound, pinnate, distichous ; lesser branches bipinnate ; pinnæ naked below, pinnulate beyond the middle ; pinnules fastigiate, bifid or multifid at the tips, and copiously fibrilliferous ; conceptacles racemose, on longish stalks. (Tab. XIII. B.)

Hab. New Bedford, Massachussetts, *Dr. M. B. Roche and Mr. C. Congdon.* Yellow Hook, New York, *Mr. Walters and Mr. Hooper.* (v. s. in Herb. T.C.D.)

Frond four to eight inches long, setaceous at base, attenuated upwards and at length capillary, divided from the base into many decompoundly pinnate branches or secondary stems. Lesser branches alternate or secund, distichous, patent, one to three inches long, bipinnate or tripinnate, oblong in outline, obtuse and fastigiate. *Pinnæ* naked for the lower half, pinnated above, the pinnulæ spreading and bifid,

trifid or multifid at the tips, so that the tips appear to the naked eye as if capitate, and dark coloured. At a later period, this character is lost by the lengthening out of the cloven tips into new ramuli. *Conceptacles* on longish stalks, abundant on the ultimate ramuli, converting them into racemes. *Tetraspores* unknown to me. Abundant dichotomous fibrils clothe the ends and sides of the ultimate ramuli. *Colour* a fine red, communicating a rosy tinge to the paper on which the plant has been dried, and to which it closely adheres. *Substance* flaccid.

I am disposed to keep this beautiful plant separate from *R. gracilis*, to which, in its soft substance and slender stems, it is most nearly allied. It differs in being still more slender, of a brighter colour, with more distichous habit. The pinnated branching is much more definite than in either *R. gracilis* or *R. subfusca*. The name is given in compliment to Dr. M. B. Roche of New Bedford, from whom I first received it, and to whom I am also indebted for many other beautiful specimens of Algæ.

VI. RYTIPHLÆA. *Ag.*

Frond filiform or compressed, decompound pinnate, transversely striate, areolated; the axis articulated, composed of a circle of large, tubular, elongated cells of equal length, surrounding a central cell ; the periphery of one or more rows of small irregularly shaped cells. *Conceptacles* ovate, pedicellate or sessile, containing a tuft of pear-shaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* contained in the terminal fusiform ramuli or in proper stichidia, in a single or double row.

The structure of the frond in this genus is very similar to that of the opaque and inarticulate portions of several *Polysiphoniæ*, in which the articulated axis, composed of symmetrical cells radiating round a central cavity, is coated externally with numerous rows of cells irregularly shaped and placed ; of these the inner ones are large and often empty, the outer gradually smaller and more constantly containing bags of coloured matter. The difference between the genera is almost wholly technical, *Polysiphonia* having at least its younger portions destitute of the peripheric layer of cells, and *Rytiphlœa* having these parts coated, though less perfectly than the other portions. The transversely striate appearance of the *Rytiphlœæ*, which is best seen with a common pocket lens, arises from the nodes of the enclosed articulated axis being visible through the coat of peripheric cells. Of course, this appearance is most obvious in the younger parts, where the cellular coat is less dense. The species of Rytiphlæa are few, and mostly tropical or subtropical.

1. Rytiphlæa? *Baileyi ;* frond compressed, areolated, irregularly branched ; branches closely bipinnate ; pinnæ alternate, nearly equal, patent ; pinnulæ subulate, subarticulate, the lowermost simple, the upper ones sometimes cloven, all slightly inflexed.

Hab. Monterey Bay, California, *Prof. Bailey.* (v. s. in Herb. T.C.D.)

Frond compressed, inarticulate, two or three inches long, half a line in diameter, divided near the base into several branches, which are closely bi-tripinnate throughout. *Pinnæ* not two lines asunder, very patent, half an inch to an inch long, compressed, closely pinnulated with subulate slender ramuli, the lowermost of which are simple and subdistant, the upper frequently again compounded, being pinnulated with a third series of ramuli. *Ramuli* acute, transversely striate and subarticulate, with hexagonal cells of nearly equal length and breadth. *Antheridia* oblong, crowding round the tips of the ramuli. Stem and branches perfectly inarticulate, areolated with polygonal cells of irregular shape and size. *Colour*, when dry, a dark purplish brown. *Substance* rigid. It does not adhere to paper.

Allied to *R. complanata*, but the surface cells are of larger size, and the ramuli more evidently articulated. Indeed, except for the habit, which is that of a *Rytiphlæa*, this plant might be placed in *Polysiphonia.*

VII. DIGENIA. *Ag.*

Frond filiform, rigidly horny, irregularly branched, inarticulate, densely cellular, the surface cells minute ; branches densely clothed on all sides with rigid, hairlike, subsimple, articulated, longitudinally striate ramuli. *Conceptacles* (unknown). *Tetraspores* lodged in the swollen ramuli.

The single species for which this genus has been set apart, though common in the Mediterranean, the Red Sea, the Indian Ocean, and in the warmer parts of the Atlantic, is still imperfectly known, its conceptacular fruit having hitherto escaped notice. In assigning it a place among the *Rhodomeleæ*, the structure has alone guided us ; the internal anatomy of the stem and branches being nearly similar to that of the same parts in *Rhodomela ;* while the ramuli are formed something on the type of those of a *Polysiphonia*, or perhaps more nearly still on those of a *Bostrychia.* The longitudinal striæ of the internodes do not consist of a single elongated cell, as in *Polysiphonia*, but of a string of cells.

Digenia *simplex*, *Ag. Sp. Alg.* 1. *p.* 388. *Digenia Wulfeni*, *Kütz. Phyc. Gen. t.* 50. *f.* 2. *Sp. Alg. p.* 841. *Conferva simplex. Wulf. Fucus Lycopodium*, *Turn. Hist. t.* 199. (Tab. XIII. D.)

Hab. Abundant at Key West, *W. H. H.* &c. Key Biscayne, *Prof. Tuomey*, (No. 61. 62).

Fronds 4-8 inches long, as thick as crow's quill, irregularly dichotomous or alternately branched; the branches either simple or bearing near the summit a second series of lesser branches; sometimes very bushy. The lower parts of the stem are generally bare, but the upper half and all the branches are very densely clothed on all sides with shaggy, setaceous ramuli, from a quarter to half an inch in length. These ramuli are filiform, simple or slightly branched, articulate, the internodes about as long as broad, coated with small cells arranged in many longitudinal lines. A cross section of a ramulus shows a central tube with two or more series of radiating cells set round it. I have not found fruit on my specimens. *Colour* when quite fresh a dark brownish red, becoming brown in drying and dirty white after exposure to the sun. *Substance* very rigid and horny, tough. In drying, the plant does not in the least adhere to paper.

A very coarse, shaggy plant, apt to be infested with numerous vegetable and animal parasites, particularly corallines. It is very difficult to find specimens free from extraneous growth, or having the ramuli perfect. In our figure the parasites are omitted.

Plate XIII D. *Fig.* 1. Digenia *simplex*, the *natural* size. *Fig.* 2. Some ramelli, springing from a fragment of the stem; *fig.* 3, portion of a ramellus; the two latter figures more or less highly *magnified.*

VIII. POLYSIPHONIA. Grev.

Frond filiform, rarely sub-compressed, articulate (at least the younger parts, the older having an articulate axis); internodes of the stem (or axis) composed of numerous, tubular, elongated cells of equal length, radiating round a central cell, and generally containing endochrome. *Conceptacles* ovate or urceolate, containing a tuft of pearshaped spores. *Tetraspores* imbedded in the distorted, ultimate ramuli.

An immense genus inhabiting all regions from the Polar basin to the equator; very variable in size and external habit—some species being two to three feet in

length, others not more than as many tenths of an inch ; some dichotomous, others pinnated—some distichous and fern-like, others with a bushy or arborescent character ; some of cobweb delicacy, lubricous and excessively flaccid, soon decomposing, others robust, rigid or tough, of strong enduring substance ;—some of a brilliant rosy red or crimson, others (and the greater number) varying through all the graver shades of red-brown, brown, and purple ; some inhabiting the deep sea, others occurring only near high water mark or far up the estuaries of tidal rivers. Plants of such varied aspect and habit could not have been brought together by the universal consent of botanists, among whom there has never been much difference of opinion respecting the just limits of this genus, if they had not some obvious bond of union in an essential, easily seen, and important common character. This is found in the structure of the stem in the articulated species, and of the axis of the stem in species which appear to be partially inarticulate ; the dissepiments being hid by the growth of a thin or thick layer of epidermal cells round the stem or branches. In such species, the proper structure of the genus may generally be seen, without dissection, in all the younger parts, as in the upper branches and ramuli. The species simplest in structure have the internodes or *articulations* of the stem and branches composed of four large cells containing endochrome or colouring matter, placed crosswise round a small, central, empty cavity, as shown in section at Pl. XVI. B. fig. 7. When viewed laterally, internodes of this structure may exhibit either two cells, or one cell and two half cells, appearing to the eye as three, the middle one twice the breadth of the others. Such stems are said to be four-tubed, or bi-tri-striate. In some species which are of this character small cells (*secondary* cells) are formed external to the four *primaries*, and alternating with them, as shown in Pl. XVII. A. fig. 6, and B. fig. 7 ; and in others, as at Pl. XVI. A. fig. 4, a thick epidermal layer of small cells surrounds the *primary* tubes, and such stems become apparently inarticulate, the *articulation* being concealed beneath the coat of small surface cells, as at fig. 5. By turning to the figures, the gradual complication of a stem of four primary tubes will be readily understood ; and the same occurs where there are more primaries than four, as at Pl. XVI. D. fig. 5, Pl. XVII. C. fig. 3, which latter figure shows the commencement of secondary tubes in a polysiphonous stem. The stem and branches of all the species are formed on one or other of these models, the number of primary tubes being sometimes as many as twenty-four.

In studying the species, it is absolutely necessary to make cross sections of the stem in order to be able to count the number of primary tubes in each internode ; for though the exact number is not of specific importance in the polysiphonous species, where we find the same species varying in different specimens from 12 to 20 tubes, yet it is essential to determine whether there be only four, or more than four ; and, generally speaking, the species with fewest tubes are most constant to their number. A little practice will enable the student to make the necessary sections with the help of a small-bladed knife and a botanical simple microscope, for which may be substituted a watchmaker's eyeglass. A small piece of a stem or branch, say a quarter of an inch long, is firmly held by the finger of the left hand upon a slip of glass under the lens, while thin slices, the thinner the better, are cut

from it. These wheel-like slices, floated in a drop of water, may then be placed under the compound microscope and examined. In slicing dried specimens, it is best to cut the stem, if possible, before it be moistened; as a thinner and cleaner cut can then be made, and the risk avoided of the too rapid decomposition from the fresh water. When the cells refuse to resume their proper shape on remoistening, a drop of muriatic acid will frequently, but not always, expand them.

Nearly 300 species of *Polysiphonia* are to be found described in various books,—Kutzing has collated 248 in his latest work. Of these, perhaps one-third are false species, founded either on solitary or on insufficient specimens. The whole require a careful revision and examination of the original materials. As in all large genera, it will be found that some species are very constant to certain characters, while others are so variable that it is nearly impossible to limit them within a short specific phrase. Of this last character are many *Polysiphoniæ*, and the knot of difficulty has too often been cut by splitting such species into several, a practice which, once admitted, leads to continual dismemberment. I shall endeavour to avoid unnecessary division in defining the American species.

Subgenus 1. Oligosiphonia. Primary tubes, four only. (Sp. 1—17.)

* *Stem visibly articulate throughout, with pellucid dissepiments.* (Sp. 1—13.)

1. Polysiphonia *urceolata*, Grev.; filaments rigid, setaceous, full-red, much branched, loosely bundled; branches subdichotomous, furnished with short, alternate, patent or recurved decompound ramuli; internodes four-tubed, those of the branches 3-5 times longer than broad, of the ramuli very short; conceptacles stalked, urn-shaped, with a projecting narrow orifice; tetraspores in the ultimate ramuli. *Grev. Fl. Edin. p.* 309. *Harv. Phyc. Brit. t.* 167. *Kütz. Sp. Alg. p.* 824. *β. patens;* with the lateral ramuli more numerous, strongly recurved, or revolute. *P. patens, Grev. Kütz. l. c. Conferva patens, Dillw. t. G.*

Hab. Arctic Sea Coast, *Dr. Sutherland!* Prince Edward's Island, *Dr. Jeans!* Halifax, *W. H. H.* Longbranch, New Jersey, *Miss Morris.* *β.* at Monterey, California, *Dr. Coulter!* (v. v.)

Tufts large, bushy and dense. *Fronds* from 6 to 8 inches long, or more, twice the diameter of human hair, decompoundly branched, generally without a leading stem; the branches alternate or subdichotomous; lesser branches subdistant, alternate or unilateral, multifid. *Internodes* in the middle part of the filament 4-6 times as long as broad, in the branches 2-3 times, in the ramuli very short. *Tubes* 4, broad, with very narrow interspaces. *Conceptacles* urnshaped, with a prominent, contracted orifice, shortly stalked, scattered over the lesser branches and ramuli. *Tetraspores* wider than the places where they occur, immersed in the ramuli in a single row. *Colour* when growing a clear blood-red, becoming dark reddish brown or even black in the herbarium. *Substance* rather rigid, not lubricous. It does not adhere strongly to paper in drying.

β. has a more evident leading stem, with long, subsimple branches set with lateral, multifid, secondary branches about an inch in length, whose divisions are closer together than in the common form. The ramuli, especially the lower ones, are remarkably patent, squarrose, or even revolute. The conceptacles, abundant, on some of Dr. Coulter's specimens, are of the ordinary form, so characteristic of this species.

2. Polysiphonia *formosa*, Suhr; filaments very flaccid, capillary, full red, much branched, branches subdichotomous, long, flexuous, furnished with scattered, spreading, alternate, attenuate, more or less compound ramuli; internodes four-tubed, those of the branches 5-10 times longer than broad, of the ramuli short; conceptacles stalked, urn-shaped, with a projecting, narrow orifice; tetraspores in the ultimate ramuli. *Suhr, Bot. Zeit.* 1831. *p.* 709. *Harv. Phyc. Brit. t.* 168. *Pol. Hooperi, Bailey MSS. Conferva stricta ? Dillw. t.* 40.

Hab. Prince Edward's Island, *Dr. Jeans!* Boston Bay, *Miss E. H. Brewer! Dr. Durkee!* New Bedford, *Dr. Roche!* Fort Hamilton and other spots in New York Bay, *Messrs. Walters! Hooper! Pike! Congdon! Calverley!* &c. (v. v.)

Tufts dense, very flaccid. *Filaments* finer than human hair, 4-8 inches long, very much branched, decompound, without obvious leading stem, alternately or subdichotomously divided, the penultimate branchlets multifid, and the ramuli frequently secund, attenuate, subulate. In some specimens, when carefully opened out, a leading stem set with alternate decompound branches may be more or less distinctly traced. The lowermost divisions of each branch are generally simple and filiform, the upper ones longer, gradually more compound, alternately pinnated in their upper half. *Apices* frequently multifid and subcorymbose. *Internodes* of the stem 5-10 times as long as broad, of the branches 3-4 times, of the ultimate ramuli very short. *Tubes* 4, broad, with narrow interspaces, and broadish, transparent dissepiments. *Conceptacles* generally stalked. *Colour* when growing, a fine, clear red, becoming darker in the herbarium, and sometimes changing to brown. In fresh water the plant soon gives out a rosy tint. It adheres very closely to paper in drying.

Except in the more slender filaments, softer and more lubricous substance, and rather longer internodes, this species does not differ from the preceding. These characters, which are obvious in the extreme forms of either species, gradually disappear when a great number of specimens from different localities are examined and compared together, and I fear that *P. formosa* can only be regarded as a beautiful variety of *P. urceolata*. Be this as it may, it seems to be the same as Dillwyn's *Conferva stricta*, a name which has many years priority to that here adopted, but which is applicable only to the immature state of the frond. I cannot distinguish *P. Hooperi*, Bail. from the ordinary form.

3. Polysiphonia *Havanensis*, Mont.; filaments short (one to three inches long), dull reddish-brown, very soft and lubricous, densely tufted, rising from creeping filaments, byssoid, four-tubed, pellucidly articulate, alternately decompound, much branched; secondary branches subdistant, often secund; ramuli filiform, fibrilliferous; internodes in the lower part of the stems once or once and a half as long as broad, in the larger branches 4-5 times, in the smaller 2-3 times, and very short in the ramuli; conceptacles . . . . ? tetraspores large, subsolitary in the ramuli. *Mont. Nat. Hist. Cubæ, p.* 34, *t.* 5, *fig.* 3. *Kütz. Sp. Alg. p.* 818.

Hab. On chalky rocks, near high water mark. Very abundant at Key West in February, *Dr. Wurdeman* (30), *W. H. H., Professor Tuomey* (1). (v. v.)

Tufts very dense, soft and gelatinous, 1, 2, or 3 inches high. *Filaments* rising from matted fibres, much finer than human hair, excessively branched in a manner between dichotomous and alternate. Branches very irregularly divided, repeatedly decompound, their apices not fastigiate, the ultimate ramuli either simple or filiform, or more or less cleft at the apex. Branches and ramuli erecto-patent. *Internodes* having the nodes slightly swollen, four-tubed, pellucidly jointed, variable in length ; in the lower part of the stem and branches usually very short, scarcely longer than their breadth, in the upper parts gradually longer, but differing greatly in different specimens ; in some pretty uniformly twice or at most thrice as long as broad, in others frequently four or five times their breadth, or even of greater length ; in the lesser branches and ramuli about twice as long as broad. *Tetraspores* of large size, mostly solitary, sometimes in pairs, much wider than the ramuli in which they are imbedded. *Colour* a deep reddish brown, varying in intensity. In drying, the plant adheres to paper, and gives out a brownish liquid in fresh water.

I am perhaps incorrect in referring my specimens, gathered within eighty miles of Havana, to the *P. Havanensis* of Montagne ; but yet, after having inspected a specimen of Dr. Montagne's plant, notwithstanding the differences it shows, I am afraid to propose mine as distinct. The chief differences which strike me are in the internodes, which are uniformly shorter in the Cuban specimen, though not so short as shown in the figure above-quoted. On the Key West specimens I find considerable variation. In the smaller and younger ones the internodes are uniformly short, while in the more luxuriant the internodes of the branches are frequently several times longer than broad ; those of the lower stem and upper ramuli being short. Dr. Montagne's specimens appear to me to be undeveloped ; mine are of various ages. I hope some algologist may investigate the question at Havana, where alone it can be satisfactorily settled.

4. Polysiphonia *subtilissima*, Mont. ; filaments short (2-4 inches long), rising from creeping filaments, densely tufted, dull purplish brown, not gelatinous, capillary or byssoid, articulate, alternately decompound ; lesser branches multifid,

attenuate, of unequal height; ramuli filiform; internodes four-tubed, about once and half as long as broad, shorter in the ramuli. *Mont. in An. Sc. Nat. 2d Ser. vol. xiii. p.* 199. *Kütz. Sp. Alg. p.* 804. *β. Westpointensis;* more slender and delicate.

Hab. Jackson Ferry, New York, *Mr. Walters and Mr. Hooper!* Little River, Newburyport, *Capt. Pike!* *β.* at West Point, on the Hudson, 60 miles from the sea, *Prof. J. W. Bailey!* (v. s. in Herb. T. C. D.)

Tufts dense, jagged, (not fastigiate), 2-4 inches high. *Filaments* very slender, capillary or byssoid, tetragonal, rising from a mat of rooting and creeping fibres, erect, alternately multifid. The main stem rises about half an inch before it branches; thence upwards it throws out several lateral branches, which are simple below, alternately multifid above, the ultimate divisions attenuate, erect or erecto-patent, of unequal height, and simple or bifid at the point. The *internodes* in the lower part of the frond are as long as broad, in the branches once and a half as long, and in the ramuli very short. *Apices* often fibrilliferous. The filaments are four angled, and a cross section shows four large tubes surrounding a small cavity. *Colour* a blackish purple, brighter toward the tips. *Substance* flaccid, but not in the least gelatinous. In drying, the plant, notwithstanding its delicacy, does not strongly adhere to paper.

This species was first discovered on the shores of Cayenne, from which locality Dr. C. Montagne has kindly sent me one of his original specimens. This I have compared with those above described, and find them to agree in all respects. The West Point plant, which was first found by Prof. Bailey several years ago, and which has been acknowledged by Dr. Montagne to belong to his species, differs from the Cayenne variety in being of still greater tenuity; a difference which we should naturally anticipate from its place of growth, nearly at the extreme limit of marine vegetation in a tidal river. I have not seen fructification of either kind on any of the specimens.

5. Polysiphonia *secunda*, Mont.; filaments minute (a quarter to half inch) rising from creeping fibres, which are either arched or prostrate, throwing out numerous erect, secund, filiform, subsimple branches; internodes four-tubed, rather longer than their breadth. *Mont. Nat. Hist. Cubæ, p.* 33, *t.* 5, *fig.* 2. *Kütz. Sp. Alg. p.* 804.

Hab. Parasitical on other Algæ. At Key West, often growing on *Digenia simplex. W. H. H.* (v. v.)

Tufts spreading over the surface of the plant on which they grow; in my specimens about a quarter inch in height. *Filaments* prostrate, creeping by means of discs issuing from the under surface, throwing up from their upper surface numerous filiform, simple, erect, secund branches. In older specimens these are often deflected or arched, and a second series of similarly secund branches spring from

them, which occasionally have one or two short ramuli. I have not seen greater composition. *Internodes* very short in the prostrate filaments, about once and half as long as broad in the erect branches, appearing three tubed on the latter view, and found by cross section to be square, composed of four large tubes surrounding a rhomboid cavity. *Colour* a dull, dark reddish brown. *Substance* rather rigid. It does not adhere firmly to paper in drying.

This species sometimes intertwines so densely among the ramelli of *Digenia* as to form with them a dense entangled mat, in which other parasites then take root. I have also seen it at Key West on *Laurenciæ*. Montagne's Cuban specimens grew on *Sargassum*.

6. Polysiphonia *breviarticulata*, Ag. tufts dense; filaments rather rigid, tetragonal, rising from a mat of creeping fibres, erect (3-5 inches long), as thick as hog's bristle, not much branched; main stem simple, or once or twice forked, somewhat naked below, beset above with numerous virgate, very erect primary branches, set at intervals with several very slender secondary branches, which are naked below and alternately multifid above; internodes uniformly shorter than their diameter in all parts of the frond, swollen at the nodes; conceptacles ovate, sessile; tetraspores in distorted terminal ramuli. *Ag. Sp. Alg.* 2, *p.* 92. *Kutz. Sp. p.* 815. *P. physarthra*, *Kg. l. c*, 815. (Tab. XVI. B.)

Hab. Abundant on maritime rocks, near highwater mark, at Key West, *W. H. H.* (No. 19), *Dr. Blodgett* (No. 57), *Dr. Wurdeman* (No. 15 and 16.) Vera Cruz, *Liebman!* (v. v.)

Tufts 3-6 inches high, dense. *Filaments* as thick as hog's bristle, sometimes nearly unbranched, sometimes thrice or four times parted subdichotomously, bare of branches and ramuli below, more or less furnished with alternate branches above. *Branches* but little divided, long and virgate, erect, furnished with several slender secondary branches, of greatly less diameter than the part they spring from. These are simple and naked in their lower half, and alternately multifid above. *Apices* abundantly fibrilliferous when young. *Articulations* in all parts of the frond much shorter than their diameter, visible to the naked eye and then appearing with opaque nodes; under the microscope pellucid, with very wide quadrate tubes and transparent interspaces. A cross section of the stem is square, with four wide tubes surrounding a small central cavity. *Conceptacles* ovate, sessile on the sides of the multifid ultimate ramuli, which on fertile specimens are shorter and more closely branched. *Tetraspores* in the tips of the ramuli. *Colour* a dull reddish brown. *Substance* rigid, not closely adhering to paper.

The Key West specimens agree with one from Vera Cruz mentioned above, but are rather more robust than the Mediterranean form, and more furnished with lateral ramuli. I had at first thought them different, and may perhaps have distributed a few specimens under the MS. name *P. littoralis*, which I gave at Key West to this plant, from its profuse abundance along the shore, near high water

mark. My specimen of *P. physarthra*, Kütz. is very imperfect, but it scarcely seems specifically different from *P. breviarticulata*, as here understood.

Plate XVI. B. *Fig.* 1. Tuft of Polysiphonia *breviarticulata* ; the *natural* size. *Fig.* 2, portion of a secondary branch, with its slender multifid tertiary ; *fig.* 3, apex of a branch, with *conceptacle ; fig.* 4, apex in which tetraspores are imbedded ; *fig.* 5, base of the stem, to show the manner of rooting ; *fig.* 6, roots ; *fig.* 7, transverse section of the stem : all the latter figures more or less highly *magnified*.

7. Polysiphonia *Binneyi*, Harv. ; filaments rather rigid, setaceous, alternately decompound, much branched ; branches elongate, spreading, of unequal length, twice, thrice, or oftener compounded, and at length resolved into capillary, multifid ramuli ; nodes swollen, pellucid ; internodes four-tubed ; those of the stem and branches once and half or twice as long as broad, of the ramuli shorter than their breadth ; tetraspore of small size, subsolitary in distorted terminal ramuli. *β.* stem and branches plentifully beset (as if proliferously) with slender, simple, or multifid capillary, lateral ramuli.

Hab. Key West, *W. H. H.* *β.* at Key West, *Mr. Binney! Prof. Tuomey*, (3) *W. H. H.* Apalachicola, *Mr. Loundsbury*. (v. v.)

Frond 2-4 inches high, as thick as hog's bristle, with an ovate outline in the spread of the branches. *Stem* subsimple, closely set throughout with lateral spreading branches, the lowest of which are long, the rest gradually shorter. These primary branches are either subsimple, or twice or thrice alternately decompound, each series of lesser branches gradually more slender, till the frond is resolved into capillary ramuli. In *β.* both stem and branches emit on all sides lateral, simple and hair-like, or multifid ramuli, half an inch long, much more slender than the internodes from which they spring, very irregularly placed, often much crowded, and often laxly scattered. The nodes of the stem and branches are swollen ; they are pellucid to the very base of the frond. Internodes of the main divisions at least once and half as long as broad, but generally rather more ; those of the younger parts uniformly short. *Tubes* four, very broad. *Colour* a deep brown. *Substance* very tough, long resisting the action of fresh water. It very imperfectly adheres to paper in drying.

Our var. *β.* has a rather different aspect, owing to the profusion of lateral ramuli. It seems, however, to be analogous to similarly proliferous states of various *Ceramia*, &c.

This species is nearly allied to *P. breviarticulata*, but is a more slender plant, with more compound and patent branches, and the internodes of all the principal divisions are uniformly of greater length. In ramification it more nearly resembles *P. Olneyi*, which has however a totally different substance.

8. Polysiphonia *fracta* ; filaments irregularly tufted or bundled together, capillary, rather rigid, divaricately much branched, subdichotomous ; branches distant, spreading at wide angles, beset with scattered, spinelike, horizontal short ramuli ; internodes four-tubed, about equal in length and breadth in all parts of the frond.

Hab. Key West, *W. H. H.* (18), *Dr. Blodgett* (42). (v. v.)

This forms loose, squarrose tufts or bundles. The filaments are rather coarser than human hair, gradually but not greatly attenuated upwards, and irregularly much branched, the main stems dividing subdichotomously. The forkings are distant and spreading, irregularly subdivided. All the branches issue at wide angles, and the larger ones are furnished with numerous, scattered, horizontally patent, thornlike ramuli, about a line in length. The substance is rather rigid. *Colour* a reddish brown. *Stem* square, four-tubed, and dissepiments pellucid in all parts of the frond. It imperfectly adheres to paper in drying.

This has the aspect of *P. subulifera*, but a very different structure. In the characters of the internodes it agrees with *P. breviarticulata*, but differs in the more slender frond and the disposition of the branches and ramuli. Dr. Blodgett's specimen is more flaccid than those I collected in February, more densely branched, with the apices fibrilliferous, characters probably dependant on the state of development.

9. Polysiphonia *echinata ;* frond setaceous, rigid, dichotomous ; branches distant, widely spreading, or divaricate, not much attenuated, articulate, four-tubed, beset on all sides with minute, spinelike, horizontal, subulate, simple or bifid ramuli, internodes shorter than their breadth.

Hab. Key West, *W. H. H.* (22). (v. v.)

Fronds three or four inches long or more, as thick as hog's bristle or somewhat thicker, subdichotomously divided ; all the divisions spreading at very wide angles. The forkings are from half an inch to an inch apart, the terminal branchlets generally an inch in length. All the younger parts, at least, are beset at intervals of half a line with minute spinelike ramuli, half a line in length, directed toward all sides, and issuing nearly at right angles with the branch. The articulations are visible in all parts of the stem and branches, uniformly shorter than their breadth, with very wide tubes and swollen dissepiments. The substance is tough and rigid, the membrane of the walls thick, and not readily recovering shape after having been dried. *Colour* a dark brown. It imperfectly adheres to paper.

This resembles *P. fracta* in its ramification, but is much more robust, and the ramuli are more copious, shorter, more compound, and more equally inserted on all sides of the branches.

10. Polysiphonia *hapalacantha*; densely tufted, soft and very flaccid; filaments setaceous and corticate below, much attenuated and articulate upwards, the terminal divisions almost byssoid, sub-dichotomously decompound, fastigiate, the lower axils patent; upper branches less regularly forked; all the branches furnished with minute, simple, scattered, spinelike, quadrifarious ramuli, and copiously clothed with byssoid (deciduous) fibres; articulations in all parts of the frond about as long as broad, four-tubed, those of the larger branches with supplementary cellules.

Hab. Key West, *Dr. Blodgett!* (v. s. in Herb. T. C. D.)

Filaments four or five inches long, branched from the base in a more or less regularly dichotomous order, the lower forks pretty regular, the upper, by the frequent suppression of an arm, subalternately decompound. The filaments are greatly attenuated upwards, the lower parts being thicker than hog's bristle, the upper branches much finer than human hair. *Axils*, especially the lower ones, patent. *Spine-like*, simple ramuli, one or two lines in length, and spreading to all sides, are freely scattered over the segments at distances of a line or two. Our specimens are copiously fibrilliferous. The articulations are uniformly short; those of the upper divisions marked with two broad tubes, those of the lower successively coated with secondary cells, but not obliterated. *Colour*, when dry, a Vandyke brown. *Substance* very soft. It closely adheres to paper.

11. Polysiphonia *Gorgoniæ;* filaments subsolitary, short (an inch high), flaccid, flabellately branched, irregularly dichotomous below, alternately decompound above, attenuated, all the divisions rather patent; ramuli of unequal length (not fastigiate); internodes near the base very short, in the larger divisions once and half as long as broad, in the smaller about twice as long as broad, four tubed; dissepiments pellucid; conceptacles globose, on short stalks, abundant.

Hab. Parasitical on various corals. Key West, *W. H. H.* (25) *Dr. Blodgett*, 40. (v. s. in Herb. T. C. D.)

Filaments rising from discoid bases, scattered, rarely somewhat tufted, an inch high, subsetaceous below, rapidly diminishing in thickness upwards, forking at two or three lines from the base, and afterwards twice or thrice forked, the upper divisions irregularly multifid and attenuated to a byssoid fineness. All the divisions are patent and the branches open out like a fan in water. The dissepiments are pellucid in all parts. The internodes four-tubed, and four angled; those in the lower part of the stem shorter than their breadth, of the branches once and half to twice as long as broad, in the ultimate ramuli very short. *Conceptacles*, which are plentifully borne on some specimens, globose, but depressed vertically or oblate, very full of spores, on short pedicels of the lesser branches or subsessile. *Colour* a pale ochrey brown, darker towards the tips. *Substance* soft and flaccid. It adheres to paper in drying. This is a very pretty little species, distinct from any of

the North American ones. I found it on the purple, whip-like Gorgonia so common at Key West.

12. Polysiphonia *Olneyi*, Harv.; tufts dense, silky, flaccid, purple-brown ; filaments capillary below, byssoid above, decompound, excessively branched ; branches very patent or divaricate, many times compounded, gradually attenuated, more or less beset with scattered, slender, spinelike ramuli ; articulations very variable in length, in the larger branches from two to six times, in the lesser branches and ramuli once and half to twice as long as broad ; conceptacles ovate, subsessile ; tetraspores in distorted ramuli. *Harv. in Olney's List of Rhode Island Plants, Proceed. Prov. Frank. Soc., Apl.* 1847. (Tab. XVII. B.)

Hab. On Zostera, &c. Halifax, *W. H. H.* Nantucket, *Dr. Durkee.* Providence, Rhode Island, (1846) *Mr. S. T. Olney.* Greenport, Long Island, *Prof. Bailey and W. H. H.* (v. v.)

Tufts from three to five inches long, dense, soft and silky. *Filaments* as thick as human hair, or sometimes twice as thick at the base, where they are also of a firm substance ; soon becoming thinner, and passing off above into excessively fine, byssoid ramuli, much branched from the base without regular order ; the branches many times compounded by alternate or unilateral ramification. *Branches* more or less furnished with lateral spinelike, scattered ramuli, from a line to a quarter inch in length. The lower divisions of the stem and branches are very patent, sometimes widely divaricating, the upper more erect, with narrower angles. A cross section of the stem, or of one of the larger branches near the base, shows four large primary tubes surrounding a central cavity, and four secondaries of small size alternating with them. The *internodes* are very variable in length in different specimens ; those of the stem and larger branches are frequently not more than twice as long as broad, but are sometimes four or even six times their length ; those of the lesser branches and ramuli are more uniformly short. *Conceptacles* ovate, abundantly scattered over the lesser branches. *Colour* a rich purple brown, more or less intense. *Substance* soft and lubricous. It adheres very closely to paper in drying.

This species has many characters in common with the following, but is a more slender plant, much softer and more lubricous in substance, with longer internodes, longer, more filiform and much less abundant ramuli, &c. It must be allowed, however, that most of these characters are variable. The length of the internodes is particularly so, the first specimens which I received from Mr. Olney, and on which I founded the species, having them uniformly short ; while others, collected in the same locality, but at a different season, have them often of the great length shown at fig. 5.

Plate XVII. B. *Fig.* 1, a frond of *Polysiphonia Olneyi*, removed from the tuft, the *natural* size. *Fig.* 2, part of a branch from the same ; *fig.* 3, a small portion of the branch with ramulus ; *fig.* 4, part of a branch from another specimen ; *fig.* 5, one of the longer internodes from the same ; *fig.* 6, a conceptacle ; *fig.* 7, transverse section of the stem ; the latter figures more or less *magnified.*

13. Polysiphonia *Harveyi*, Bail.; tufts globose and bushy; filaments rather rigid, setaceous, divaricately much branched; branches alternately decompound, very patent, often angularly bent, set throughout with more or less numerous, short simple, or forked, spinelike ramuli; internodes short in all parts of the frond, once or twice as long as broad in the branches, much shorter than their breadth in the lesser divisions and ramuli, four-tubed; dissepiments pellucid; conceptacles broadly ovate near the tips of the branches; tetraspores in distorted ramuli. *Bail. in Sillim. Journ.*—(Tab. XVII. A.)—*β arietina*; very squarrose, the ramuli strongly revolute and curled. *Pol. arietina*, *Bail. MS.*

Hab. On Zostera and other marine plants. Boston Bay, *Dr. Durkee*, *Mrs. Mudge*, *Mr. Girard*, *etc.* Abundant in Long Island Sound; Stonington, *Prof. Bailey* (1846); Greenport, Long Island, both varieties, *Prof. Bailey and W. H. H.*

This forms globose, squarrose, loose tufts, which do not collapse, when lifted from the water, if the plant be quite fresh. *Filaments* often, but not always, as thick as hog's bristle at the base, attenuated upwards, excessively branched and bushy; the branches dividing repeatedly without much order, alternate or secund, widely spreading, often much divaricated. Lesser branches variable in number and in subdivision, sometimes very few and little divided, sometimes numerous. *Ramuli* generally very abundant, half a line to a line long, spinelike, simple or forked, subulate, very patent, sprinkled irregularly over all the branches, large and small. *Internodes* generally very short in all parts of the stem and branches, but variable in length in different specimens and at different ages. Those of the lower part of the stem show, on a cross section, four primary and four small secondary external tubes. Those of the branches are sometimes shorter than their breadth, sometimes twice as long; in the latter case the coloured tubes are often spirally twisted. The pellucid integument of the filament is thick, and the nodes are generally swollen. *Conceptacles* broadly ovate, usually placed near the ends of the branches. *Tetraspores* of small size, in distorted ramuli. *Colour* a very dark, purplish brown. *Substance* firm, rigid. In drying, the plant adheres, but not firmly, to paper.

β is smaller, and still more squarrose, with its spinelike ramuli strongly recurved or rolled back like a "ram's horn." I think, however, that I have traced it, through numerous specimens, into the ordinary form. Sometimes the frond is much more densely branched than our figure, taken from one of the original specimens, shows. The obvious characters of the species are the abundant thornlike ramuli and short joints.

This plant is common in various places in Long Island Sound. While dredging with Professor Bailey in Peconic Bay, our exclamations of delight on hauling up some specimens of it attracted the notice of one of our boatmen, who took up a handful of what we seemed so eagerly hoarding, but immediately threw it down with a "Pooh! that's what *we* call '*nigger-hair*.'"

Plate XVII. A. *Fig.* 1, frond of Polysiphonia *Harveyi*, the *natural* size. *Fig.* 2, apex of a branch; *fig.* 3, ramulus with tetraspores; *fig.* 4, a tetraspore; *fig.* 5,

portion of a branch, with ramuli and a conceptacle ; *fig.* 6, transverse section of the stem ; all the latter figures more or less highly *magnified.*

** *Stem and larger branches inarticulate, more or less completely coated with small, irregular cellules. Ramuli articulate.* (Sp. 14—17.)

14. Polysiphonia *ramentacea;* stem robust, dendroid, inarticulate, internally four-tubed, irregularly much branched; branches spreading on all sides, alternately divided ; lesser branches rod-like, simple, set throughout with numerous, short, setaceous, spine-like, simple or forked, articulate ramuli; internodes of the ramuli shorter than their breadth, marked with two or three quadrate cells; conceptacles ovate, borne near the tips of the ramuli. (Tab. XVI. A.)

Hab. On corals, &c. Key West, *W. H. H., Dr. Blodgett.* (v. v.)

Root discoid. *Stem* solitary, four or five inches high, twice or thrice as thick as hog's bristle, gradually attenuated upwards, soon forking, and afterwards repeatedly divided in an irregularly alternate manner, the whole system of branches forming a tree-like frond. The larger branches spread towards every side, and are furnished with numerous lateral, secondary branches, scattered or crowded, and either simple or having another series of similar branches, all tapering to a fine point. The stem and branches are alike beset, at distances of half a line or less, with slender, simple or forked, bristle-shaped, quadrifarious ramuli, a line or two in length. These ramuli are pellucidly articulate, the articulations exceedingly short, with sub-quadrate tubes. The stem and branches are opaque, tessellated with small irregular cells; a transverse section showing four primary tubes, with an external coating of greater or less thickness formed of small cells. *Conceptacles* ovate, small, sessile near the tips of the ramuli. *Antheridia* ovato-lanceolate, densely tufted at the apices of the ramuli. *Colour* a dull reddish brown, darkening in drying. *Substance* cartilaginous, but soft. In drying, it adheres pretty closely to paper.

Of this apparently rare species, I collected only a solitary specimen during my visit to Key West. It is abundantly unlike any other North American species, but nearly allied to *P. flexella* of the Mediterranean. My specimen, however, differs from any that I have seen of *P. flexella;* it recovers better after having been dried, the articulations of the ramuli are more distinct, and the byssoid fibres far less copious.

Plate XVI. A. *Fig.* 1. Polysiphonia *ramentacea;* the *natural* size. *Fig.* 2, apex of a branch; *fig.* 3, portion of a ramulus; *fig.* 4, transverse section of a branch; *fig.* 5, lateral view of a small portion of the same, to show the surface cells; the latter figures more or less highly *magnified.*

15. Polysiphonia *elongata*, Grev. ; stems robust, cartilaginous, irregularly branched, decompound, best, especially toward the end of the branches, with slender, closely set, alternately multifid ramuli, which taper to the base and apex ; articu-

lations of the stem and branches areolated with small, irregular cells, more or less obsolete; of the ramuli once and a-half or twice as long as broad, marked with numerous (secondary) tubes and small cells; primary tubes four. *Ag. Sp. Alg. vol.* 2. *p.* 82. *Kütz. Sp. Alg. p.* 828. *Harv. Phyc. Brit. t.* 292 *and* 293.

Hab. Boston Harbour in various places, rare? Lynn Beach, *Dr. Durkee.* Germantown, *Miss E. H. Brewer.* (v. v.)

Root a large scutate disc. *Fronds* mostly solitary, 6-12 inches long, cartilaginous, firm, as thick as packthread at the base, gradually attenuate upwards, decompoundly branched in a manner between dichotomous and alternate; the branches sometimes bare of ramuli, long and twiggy; and sometimes emitting, especially from their upper half, broad pencils of multifid, rosy or blood-red flaccid ramuli. Internodes obscurely visible in all the older parts of the frond, distinctly marked in the ramuli alone, about once and half as long as broad, sometimes a little longer, netted over with irregularly shaped, polygonal cells. A cross section shows four primary tubes of a large size, protected externally by several rows of irregularly placed cells, which are gradually smaller to the circumference. *Conceptacles* ovate, scattered over the branches. *Tetraspores* in the distorted tips of the flaccid ramuli. *Colour* red-brown in the stem, rosy or blood-red in the ramuli. In drying, the stem scarcely adheres to paper, except after strong pressure, but the ramuli, when present, adhere very closely.

A most variable plant in aspect. Specimens of the first year's growth have a very few flaccid ramuli scattered along the twiggy branches. In winter these, as well as the ends of the branches, fall away, leaving a truncated or somewhat pollarded frond. In the following spring, such as survive throw out a profusion of byssoid and multifid ramuli, which are peculiarly abundant and dense round the wounded parts.

16. Polysiphonia *fibrillosa*, Grev.; pale straw-colour or brownish; stems inarticulate, opaque, marked with sinuous veins, robust, alternately branched; branches spreading, resembling the stem, but less opaque, articulated near the ends, sub-simple, thickly set with very slender, articulated, finely divided, short ramuli, whose tips are copiously fibrilliferous; internodes of the ramuli, rather longer than broad, bi-tri-striate; primary tubes four, in the stem coated with a thick layer of cells; conceptacles ovate; tetraspores large, in the terminal ramuli. *Ag. Sp. Alg. vol.* 2. *p.* 78. *Kütz. Sp p.* 827. *Harv. Phyc. Brit. t.* 302.

Hab. Newport, Rhode Island, *Prof. Bailey.* Lynn, Massachussetts, and Peconic Bay, *Mr. Hooper.* (v. v.)

Tufted. *Stems* once or twice as thick as a hog's bristle, alternately much branched, the lateral branches spreading irregularly on all sides, repeatedly compound; the main stem and principal and lesser branches opaque and inarticulate,

coated with oblong, sinuous, irregular cells. The smaller branches are gradually resolved into alternately multifid, articulated ramuli. *Internodes* of the ramuli about as long as broad, or a little longer. A cross section of the stem shows four primary tubes, surrounded by many rows of cells, smaller gradually to the circumference ; the four secondary tubes (alternating with the primaries) large. Ends of the branches and ramuli with abundant byssoid fibrils. *Conceptacles* broadly ovate, subsessile. *Colour* a dull, pale red brown. *Substance* soft, soon decomposing. In drying, it adheres very closely to paper.

This scarcely differs from the following except in the duller colour, less divided ramuli, and shorter internodes. This is the plant published as *P. Brodiæi* in Prof. Bailey's list. I have examined his specimen and find but four primary tubes in the stem ; not six, as in *P. Brodiæi.*

17. Polysiphonia *violacea*, Grev. ; brownish red or purple ; stem inarticulate, marked with irregular cells, robust, alternately branched, decompound ; branches quadrifarious, repeatedly divided, bushy or feathery, the ultimate ramuli exceedingly slender, alternately multifid, fibrilliferous ; internodes of the ramuli bistriate, two to four times as long as broad ; primary tubes four, in the stem coated with a thick layer of cells ; conceptacles ovate, stalked or subsessile ; tetraspores in swollen submoniliform ramuli. *Ag. Sp. Alg. vol.* 2, *p.* 76. *Kütz. Sp. Alg. p.* 826. *Harv. Phyc. Brit. t.* 209.

β flexicaulis ; stem and branches more slender than common, angularly bent, excessively divided, the lesser divisions very patent and frequently secund; internodes of the ramuli rather longer than usual.

Hab. On Zostera, &c., frequently in deep water, beyond tide marks. Penobscot Bay, Maine, *Mr. Hooper.* Boston Bay, *Mr. G. B. Emerson*, *Dr. Durkee*, *Capt. Pike.* New Bedford, *Dr. Roche*, *Mr. Congdon.* Seaconnot, *Mr. Congdon.* *β.* Prince Edward's Island, *Dr. Jeans.* Profusely common in Halifax harbour in July, *W. H. H.* (v. v.)

Subsolitary, or loosely tufted. *Stem* 6—12 inches long, or more, as thick or twice as thick as hog's bristle below, gradually attenuated upwards, simple or but slightly divided, set throughout with lateral, spirally inserted branches, the lowest of which are longest, the rest gradually shorter upwards. *Branches* elongate, bearing a second or third series of similar but shorter branches, the last of which are alternately multifid, and resolved into excessively slender, finely divided ramuli, the minute division of which, in luxuriant specimens, gives the plant a feathery aspect. The stem and larger branches are opaque, marked with numerous, irregularly shaped, veiny cells, without apparent articulation, the nodes being hidden under the cellular coat. The lesser branches and ramuli are pellucidly articulate, the internodes of the former being three or four times, of the latter about twice as long as broad. *Conceptacles* generally pedicellate. *Colour* varying from brown to purple, often becoming brighter after the plant has been dried. *Substance* of the

stem cartilaginous, but tender; of the branches and ramuli very flaccid, soft and lubricous. It adheres most closely to paper in drying.

Var. β, which I dredged in great profusion at Halifax harbour, where, in July and August, it is one of the most characteristic plants, is often two feet long or more, and excessively and almost intricately branched. The main stem and branches are remarkably flexuous, bent from side to side in a zigzag manner, and their lesser divisions are very frequently secund. Except in these characters, which I do not think of specific importance, this variety does not differ from the ordinary form.

Sub-genus 2. Polysiphonia. Primary tubes more than four. (Sp. 18—28.)

18. Polysiphonia *variegata*, Ag.; tufts dense, brownish purple or greenish; filaments setaceous and rigid below, capillary above, dichotomo-multifid, the lower axils very patent; branches somewhat zigzag, elongated, furnished with lateral, capillary, very flaccid, multifid, purple ramuli; internodes near the base shorter than their breadth, once and half to twice as long as broad in the branches and ramuli, three banded; tubes six; conceptacles ovate, short-stalked. *Ag. Sp. Alg.* 2. *p.* 81. *J. Ag. Alg. Medit. p.* 129. *Harv. Phyc. Brit. t.* 155.

Hab. On Zostera, &c. Annual. Massachussetts Bay, *Dr. Durkee*, *Mr. Pike*. Peconic Bay, *Prof. Bailey* and *W. H. H.* Several places in Long Island Sound. New York, *Mr. Hooper*, *Calverley*, &c. Sullivan's Island, Charleston, *Prof. Gibbes*, *W. H. H.* &c. (v. v.)

In fine tufts. *Filaments* as thick as hog's bristle below, capillary and byssoid above, two to ten inches long, dichotomous below, repeatedly forked, alternately or irregularly decompound above; the lower divisions spreading with very wide angles and subdistant, the upper gradually more erect. In some specimens the whole frond has a flabelliform outline and is pretty equally dichotomo-multifid, none of the pencils of ramuli crowding on each other; in others the principal stems are a few times divided, nearly flexuous or zigzag, and alternately set with pencils of closely dichotomous, crowded, subfastigiate ramuli. *Internodes* visible to the base of the frond, and, except near the base where they are very short, pretty regularly once and half or twice as long as broad, showing three tubes on the lateral view, and a circle of six (rarely seven) round a small central cell, when cut across. No secondary tubes except toward the base of old stems. *Apices* attenuate, with very short joints. *Colour* a dark, purple brown or blackish purple, becoming a brighter purple after having been dried. The substance is soft and lubricous, but not very gelatinous, and the plant adheres closely to paper in drying. *Conceptacles* broadly ovate or subglobose, widemouthed, pedicellate, scattered over the branches.

This plant, though in some respects variable, has a peculiarity of aspect which

renders it, after it has once been seen, easily recognised in the several varieties it assumes. It is the only species yet found in Charleston Harbour, where in January and February it is very abundant. It extends north as far as Boston, where it is a summer plant. In Europe it is a characteristic Adriatic species, and is found along the Atlantic coast as far as the south of England.

19. Polysiphonia *parasitica*, Grev. ; filaments slender, rigid, full red, decompound-pinnate, distichous ; branches bi-tri-pinnate ; pinnules closely set, alternate, erecto-patent, awl shaped, acute ; internodes about as long as broad, about four-banded ; dissepiments hyaline, wavy ; tubes about eight ; conceptacles ovate, on short stalks ; tetraspores immersed in swollen pinnules. *Grev. Fl. Edin. p.* 309. *Harv. Phyc. Brit. t.* 147. *Ag. Sp. Alg.* 2, *p.* 103. *Kütz. Sp. Alg. p.* 803.

Hab. Providence, Rhode Island (fide Sp. in Herb., Hooper).

One to three inches high, distichous, repeatedly pinnate. *Colour* when growing a clear lake-red, becoming brownish in drying. It imperfectly adheres to paper.

Apparently a rare species in America. I have only seen a solitary specimen in the collection of Mr. Hooper of Brooklyn. It is a beautiful plant resembling a miniature *Ptilota* in outward aspect.

20. Polysiphonia *Pecten Veneris* ; small (1-2 inches high), capillary, alternately branched ; branches flexuous, sometimes many times compound, spreading or reflexed ; lesser branches pectinated on one side with secund, bristle-shaped, short ramuli, issuing from every node ; internodes nine or ten tubed, about once and half as long as broad, those of the ramuli shorter ; tetraspores immersed in the ramuli ; conceptacles ovato-rostrate, on long peduncles ! Var. *α.* much branched, the comblike branches strongly recurved. (Tab. XVI. C.) Var. *β.* less branching, the comblike branchlets elongate, straight or nearly so. (Tab. XVI. D.)

Hab. On small Algæ and corallines. Key West, *W. H. H.* (20). *Dr. Blodgett*, (70). Pine Islands, *Prof. Tuomey* (26). (v. v.)

Filaments decumbent at base and creeping, then erect, capillary or subsetaceous, much branched, distichous. *Branches* alternate, flexuous, spreading at wide angles, repeatedly divided, the successive divisions usually secund. All the lesser branches and portions of the branches and stem are furnished, at intervals of less than a quarter of a line, with secund, subulate, or bristle-shaped ramuli about a line in length, so that each penultimate branchlet with its ramuli resembles a miniature comb. These little combs in the larger and more branching specimens are generally strongly reflexed, the ramuli curving in an opposite direction. A transverse section of the stem shows nine or ten tubes. The internodes are rather longer than

broad in the ramuli, and once and half to twice their breadth in the branches. *Conceptacles* ovato-urceolate, acuminate, or produced at the orifice into a long beak, borne on peduncles longer than themselves, often twice as long, originating on the principal branches of the frond, and more than twice the diameter of the ordinary ramuli. *Tetraspores* immersed in the ramuli. *Colour* a brown red of variable intensity ; in old specimens the branches are sometimes colourless while the ramuli are strongly coloured. *Substance* soft. It adheres, but not very strongly, to paper in drying.

The smaller and less branching specimens resemble *P. obscura*, but are much more delicate ; the larger are quite unlike any other North American species. Since our figure was prepared I have received from Dr. Blodgett specimens bearing conceptacles. These are very curious, shaped like those of *Dasya elegans*, and borne on still longer peduncles.

Plate XVI. C. *Fig.* 1. Polysiphonia *Pecten Veneris* ; the *natural* size. *Fig.* 2. part of a branch *magnified ; fig.* 3. ramulus, with tetraspores, more highly *magnified.* D. Figs. 1 and 2, var. *β.* the *natural* size. *Fig.* 3, part of a branch ; *fig.* 4, small piece of the same and ramulus with tetraspores ; *fig.* 5, cross section of a branch ; the latter figures more or less *magnified.*

21. Polysiphonia *exilis* ; filaments densely tufted, creeping, afterwards ascending or suberect, furnished with a few distant, secund, unequal, filiform ramuli ; internodes shorter than their breadth in all parts of the frond ; tubes nine ; tetraspores in the ramuli.

Hab. Key West, *W. H. H.* (24) *Dr. Blodgett*, (v. v.)

Densely tufted. *Filaments* matted together at base and there attached by lateral rooting fibres ; afterwards ascending or sub-erect, about an inch in length or rather more, ultra-capillary, generally simple, furnished at short intervals with numerous very unequal, secund ramuli, long and short often indiscriminately ranked together, the ends of the filaments generally bare. *Internodes* very short, about half as long as broad, with pellucid dissepiments. A cross section shows nine tubes. *Tetraspores* in distorted ramuli. I have not seen conceptacles. *Colour* a dark brown red, becoming much browner in drying. *Substance* coarse and rather rigid. It imperfectly adheres to paper in drying.

Allied to *P. obscura*, Ag. ; but more robust, and yet with fewer and broader tubes. I also collected at Key West one or two specimens of a *Polysiphonia* nearly allied to this, differing in being less robust, less branching, having longer internodes and a rather brighter colour. As the specimens are not in a very good state, I am unwilling to give them a name at present, and thereby add to the sufficiently numerous list of bad species in this genus.

22. Polysiphonia *atrorubescens*, Grev. ; filaments setaceous, erect, sparingly or much branched, dark red, somewhat rigid ; branches long, alternate, very erect, alternately decompound, naked or furnished with short, simple or multifid, scattered, acute ramuli, which taper to the base and apex ; internodes of the branches twice or thrice as long as broad, of the ramuli shorter than their breadth, twelve tubed; the tubes frequently spirally twisted ; conceptacles broadly ovate or sub-rotund, sessile, tetraspores in the ramuli. *Ag. Sp. Alg. vol.* 2. *p.* 64. *Harv. Phyc. Brit. t.* 172. *Pol. Agardhiana, Grev. Scot. Crypt. H. t.* 210. *Conferva atrorubescens, Dillw. t.* 70.

Hab. Little Compton, *Dr. Durkee.* Longbranch, New Jersey, *Miss Morris*, (v. v.)

Stems densely tufted, two or three inches long in our American specimens, as thick as hog's bristle, irregularly branched, not much tapered upwards ; branches long and virgate, sub-simple, very erect, here and there furnished with a few alternately multifid ramuli, which taper to the base and apex, and are thus spindle-shaped. Larger specimens are often more compound. *Internodes* about twelve tubed, twice as long as broad in the branches, shorter in the ramuli and toward the base of the stem, multistriate, the tubes very frequently, but not always, spirally twisted. *Conceptacles* broadly ovate, wide-mouthed, sessile near the ends of the ramuli. *Tetraspores* of large size, in the distorted ramuli. *Colour* when growing, a full deep-red, changing to reddish-brown in the herbarium. *Substance* rather rigid. It does not strongly adhere to paper in drying.

Miss Morris's specimens are in fruit, of both kinds, and have all the usual characters of the European plant, from which they differ merely in being less luxuriant. Dr. Durkee's are not fully grown, and the tubes are straighter than usual. I see no sufficient reasons for doubting that both belong to the same species.

23. Polysiphonia *Californica;* flaccid, capillary, densely tufted; filaments dividing near the base into subsimple, elongate, flexuous branches, which are naked below, and set with short, alternate, secondary branches above; secondary branches pinnate or bipinnate, the pinnules tapering to the base and apex ; internodes many-tubed, those of the branches nine or ten times, of the ramuli about twice as long as broad.

Hab. Golden Gate, California, *Captain N. Pike.* (v. s. in herb. T. C. D.)

Densely tufted. *Filaments*, so far as I can judge from the imperfectly extricated specimens before me, divided near the base into several long branches. These branches are four or five inches long, simple or nearly so, flexuous, capillary, bare of lesser branches below and furnished above, for two thirds of their length, with lateral, secondary branches from a quarter inch to an inch in length, and at distances apart varying from nearly an inch to one or two lines; the lowest most distantly placed. The simplest of the lateral branches are naked for more than half their length and pinnated in the remaining portion; the more compound are

similar but bipinnate, each of their pinnæ being naked below and pinnulate above. The pinnules are very erect and taper to the base and apex. The tubes in the specimen examined are nine or ten in the stem. The internodes are distinctly visible in all parts of the frond; those of the main branches are very many times longer than broad, and have the tubes often spirally twisted; those of the smaller branches and pinnæ are uniformly short, once and a half to twice as long as broad; and those of the pinnules are about as long as their breadth. The substance, though tenacious, is very flaccid. The colour, probably full red in the recent plant, is a dark red brown in the dried specimen. In drying, it does not adhere very closely to paper.

This is allied in many respects to *P. atrorubescens*, from which it differs in tenuity and in general aspect, as well as in the much greater length of the internodes of the larger branches. These latter characters connect it with *P. tenuistriata* of the Southern Ocean, and perhaps future observations may oblige us to unite it to that species; but at present we have not evidence to warrant our doing so.

24. Polysiphonia *nigrescens*, Grev.; frond robust, rigid and rough with broken branches below, flaccid much branched and bushy above; branches alternate, decompound pinnate; ramuli distant, elongate, awl-shaped, alternate, the upper ones pinnulate near the tips; internodes of the branches rarely shorter than their breadth, often once and half to twice or four times as long as broad, multistriate; tubes from twelve to twenty; conceptacles ovate, sessile or nearly so. *Ag. Sp. Alg.* 2, *p.* 69. *Kütz. Phyc. Gen. t.* 50, *f.* 4. *Sp. Alg. p.* 813.

Of this most variable plant I have received the following forms from America :—

fucoides; robust, excessively branched and bushy; branches sub-spirally inserted, many times pinnated, the lesser branches sub-bipinnate, fastigiate and sub-corymbose; pinnules naked below, pinnulate above; internodes of the branches once and half to twice, of the ramuli once and half as long as broad; tubes of the stem varying from twelve to twenty. *Pol. nigrescens, Harv. Phyc. Brit. t.* 277. *P. fucoides, Grev. Edin. p.* 308. *Conferva fucoides, Dillw. t.* 75. *E. Bot. t.* 1743.

β. *affinis*; robust, elongate, repeatedly pinnate but rather laxly branched, the principal branches naked below, decompound pinnate above; the lesser branches somewhat fastigiate and corymbose; internodes of the branches three or four times, of the ramuli once and half to twice as long as broad; tubes 15-16. *Pol. affinis Moore; Harv. Phyc. Brit. t.* 303.

γ. *plumosa*; stem setaceous, undivided, pinnated with lateral, alternate or secund, sub-distant, decompound branches; branches lanceolate in outline, three or four times pinnate, plumose, the apices not fastigiate; ramuli very slender, erecto-patent; internodes of the branches 2–4 times, of the ramuli once and half to twice as long as broad; tubes seventeen or eighteen.

δ. *gracillima*; stem setaceous, undivided, pinnated with capillary elongate

branches ; branches bi-pinnate, both pinnæ and pinnules distant, very slender and irregularly placed ; internodes of the branches 4–8 times, of the pinnules twice or thrice as long as broad ; tubes twelve.

ε. tenuis ; stem setaceous, decompound-pinnate ; branches sub-distichous, ovate in outline, 3–4 times pinnate ; the pinnæ and pinnulæ patent and rather distant, not fastigiate ; internodes of the pinnæ 3–4, of the pinnules 2–3 times as long as broad ; tubes fifteen.

Var. *ζ. Menziesii* ; setaceous, alternately branched, distichous ; branches virgate, bi-pinnate ; pinnæ sub-distant, pinnulæ subulate, the lowermost squarrose or revolute, simple, the upper erecto-patent, simple or alternately multifid ; internodes of the branches twice or thrice as long as broad, of the ramuli shorter than their breadth ; tubes twelve or thirteen.

η. disticha ; stem setaceous, decompound-pinnate, distichous ; branches bi-tri-pinnate, with a subdefined, oblong or ovate outline, the pinnæ and pinnulæ remarkably patent ; internodes of the pinnæ rather shorter than their breadth, of the pinnules as long as broad ; tubes eleven or twelve.

θ. Durkeei ; robust, compressed, decompound-pinnate, distichous ; branches with a definite, oblong outline, bi-tripinnate ; pinnæ naked at base, pinnulate above, pinnules erect ; all the internodes much shorter than their breadth. *Pol. Durkeei. Harv. MSS.* (Tab. XVII. C.)

Hab. In rock pools between tide marks, and in deep water, attached to rocks and shells, &c. Perennial. Var. *α* Sitcha, *Barclay !* Prince Edward's Island, *Dr. Jeans.* Nahant, *W. H. H.* Newburyport, *Miss Townsend.* Staten Island, *Prof. Bailey.* Red Hook and Fort Hamilton, *Messrs. Hooper, Pike, Walters, &c., W. H. H.* *β.* Halifax, *W. H. H.* *γ.* New Bedford, *Dr. Roche.* *δ.* Yellow Hook, New York, *Mr. Walters.* *ε.* Ship Anne Point, *Messrs. Walters and Hooper.* Boston Bay, *Capt. Pike.* New Bedford, *Dr. Roche.* *ζ.* West Coast, *A. Menzies, Esq.* (1788). *η.* Newport, *Mr. Olney.* Long Island Sound, *Capt. Pike.* Fort Hamilton, *Messrs. Hooper, Walters, Congdon.* *θ.* Germantown, *Dr. Durkee.* New Haven, *Dr. Durkee and Mrs. Babcock.*

Some of the above varieties are so unlike the normal form of this species (our var. *α. fucoides*), that were there not intermediate states they might readily pass for distinct species. The number of tubes in the stem is extremely variable in different specimens, even where there is no other difference. In some I have found them as few as eleven, in others as many as eighteen ; the more common numbers being twelve and fifteen. The length of the internodes is more constant in the several varieties, when the penultimate divisions of the frond are compared. The best general marks for the species are its decompound, pinnate branching, penultimate ramuli, naked below and pinnulate above the middle, and many tubed internodes of moderate length.

Var. *α. fucoides. Stems* 6 12 inches long, as thick or twice as thick as hog's bristle, rigid below, flaccid above, many times decompound ; the lesser branches very dense and bushy, of equal length ; the ultimate ramuli very erect, fastigiate,

crowded toward the ends of the branches. *Conceptacles* scattered on the ramuli. *Internodes* seldom more than twice as long as broad, often shorter. *Tubes* 12-13-15 18-20 in different specimens. Lower part of the stem somewhat opaque, partially coated with surface cells. *Colour* a blackish purple. *Substance* tough. A common North American form.

Var. β. *affinis*. *Stems* 12-18 inches long, thicker than hog's bristle, more distantly branched than var. α, with the branches more naked in their lower half. This variety, which I believe always grows in deep water, beyond tide marks, is further remarkable for the greater length of internodes of the stem.

Var. γ. *plumosa*. *Stems* 8-10 inches long, as thick as hog's bristle, undivided, but set throughout at short distances with lateral branches, the lowest of which are longest, the upper gaadually shorter, giving the general frond a pyramidal outline. These branches are lanceolate in outline, slender, and many times pinnated, the decompound ramuli being capillary and almost byssoid. *Internodes* of the lesser branches thrice or four times as long as broad ; opaque towards the base of the stem. *Colour* a purplish brown. *Substance* soft and flaccid. In drying, all parts, except the base of the stem, adhere closely to paper.

Var. δ. *gracillima*. *Stem* 8-10 inches long, scarcely as thick as hog's bristle below, capillary above, laxly set with distantly pinnated, slender, capillary branches. *Ramuli* but slightly compound. *Internodes* of the branches very long ; from five to six or eight times as long as broad, of the lesser branches shorter. Of this variety I have seen but a solitary specimen, which is so unlike the ordinary state of the species, that I had at first considered it specifically distinct ; but it seems, on closer examination, to be intermediate between the preceding and following forms. The great length of the internodes is, however, a striking peculiarity.

Var. ε. *tenuis*. *Stem* 6-10 inches long, as thick as hog's bristle, attenuated upwards, decompound pinnate ; branches closely set and three or four times compounded, the pinnæ and pinnulæ sometimes subdistichous, sometimes spirally spreading. Internodes of the branches 4-5, of the pinnæ 3-4, of pinnules thrice as long as broad. *Colour* a blackish brown. Substance flaccid, but not lubricous. In drying, it does not strongly adhere to paper. Not an uncommon American form. It has the aspect of var. α, but is much more slender, and has much longer internodes.

Var. ζ. *Menziesii*. *Stems* 3-4 inches high, as thick as horse hair, distantly branched ; branches alternate, virgate, naked below, or with a few distant squarrose or revolute simple ramuli, bipinnate above, narrow oblong in circumscription, distichous. *Pinnæ* half an inch long, the lowest pinnulæ frequently recurved or curled, the upper erectopatent. *Tubes* 13. *Colour* dark brown. Characterised by the squarrose or revolute ramuli. The specimens described are marked "*Rhodomela floccosa*" in the Menziesian Herbarium. A specimen of the true *R. floccosa*, which was first discovered by Mr. Menzies, is fastened on a separate sheet. Our plant is much smaller and more slender, and the microscopic analysis very different. Though peculiar as a form, I do not think it can be separated by essential characters from *P. nigrescens*.

Var. η. *disticha*. *Stem* as thick as hog's bristle, 4-6 inches long, distichously

branched ; the main stem and branches somewhat angularly bent. All the divisions patent, and all the internodes short. *Substance* rigid. *Colour* very dark. This variety is readily known by its patent, distichous branches, rigid substance, and internodes uniformly shorter than in the preceding forms, with which it seems to connect the following.

Var. *θ. Durkeei. Stem* 2-3 inches high, thicker than hog's bristle, compressed (?), distichously branched, repeatedly pinnate ; the main stem either simple or forked, with several lateral branches. *Branches* definitely circumscribed, round-topped, bi-tripinnate, the pinnæ a line asunder, patent ; pinnules subulate and erect. *Articulations* visible in all parts of the frond, and uniformly much shorter than their diameter. *Colour* a dark brown. *Substance* rather rigid. This plant, which I first received from Dr. Durkee of Boston, is so unlike many of the preceding varieties, particularly those called *plumosa* and *gracillima*, that few persons, on a mere inspection of a solitary specimen, would suspect them to belong to the same species ; and when first I examined Dr. Durkee's specimen I regarded it as specifically distinct, and hoped it might be allowed to bear his name. A more extended reference to other specimens from various quarters now induces me to consider it a very extreme form, in which the characters of the var. *disticha* are exaggerated.

Plate XVII. C. *Fig.* 1. Polysiphonia *nigrescens, var. Durkeei* ; the *natural* size. *Fig.* 2, part of a branch and ramulus ; *fig.* 3, cross section of a branch ; both *magnified.*

25. Polysiphonia *Woodii;* stem robust, flexuous, strongly compressed, distichously branched, decompound-pinnate; pinnæ (or primary branches) distant, patent, tri-quadri-pinnate, the pinnules pinnato-multifid; ultimate ramuli subulate, incurved; internodes in all parts of the frond very much shorter than their diameter, many striate, with pellucid dissepiments, those of the stem with two (!) axes of radiation; tetraspores in a single row in the ramuli.

Hab. On the Pacific Coast, in lat. 38° 12′, Lieut. Wood (1846). Golden Gate, California, *Capt. N. Pike* (1851). (v. s. in Herb. Hook. et T. C. D.)

Frond (in the largest specimen seen by me) about 5 inches long, twice as thick as hog's bristle, compressed, somewhat zigzag, distichously branched ; the branches half an inch asunder, alternate, patent, one to two inches long, nearly equal, decompound pinnate, their primary pinnæ half an inch long, about three or four times pinnately parted, all the laciniæ alternate. The ultimate ramuli are subulate, acute, incurved, not a line in length. Every part of the frond is exactly distichous. The internodes are visible throughout with the help of a pocket lens, and are much shorter than their breadth, about ten striæ or tubes being visible on a lateral view in the ramuli, and a greater number on the larger branches. All the interspaces are pellucid ; in the stem only are the internodes partially coated with secondary cellules. A transverse section of the stem is a long ellipse, having two axes (or foci) round which the tubes radiate, a structure which I have never seen in any

other species. *Conceptacles* unknown. *Tetraspores* of large size, forming a single row through the centre of the ultimate ramuli. *Colour* a brownish red. *Substance* soft, but not soon decomposing. In drying, the plant adheres closely to paper.

A very remarkable species, abundantly different from any other North American one known to me. I wish it to bear the name of Lieut. Wood, R. N., who, while cruising in the Pacific Ocean in H. M. S. "Pandora," collected several interesting Algæ, which he communicated to Sir Wm. J. Hooker, in whose Herbarium I have examined them. I have recently received from Mr. N. Pike of Brooklyn a Californian specimen agreeing in all characters with Lieut. Wood's original one.

26 Polysiphonia *dictyurus*, J. Ag.; filaments tufted (1-2 inches high) capillary, rather rigid, sparingly branched; branches virgate, simple, set throughout with short, pinnato-multifid, squarrose, quadrifarious ramuli, which are densely crowded toward the ends of the branches; internodes visible throughout, many-tubed, much shorter than their breadth. *Kütz. Sp. Alg. p.* 838.

Hab. Pochetti, Pacific Coast of the Mexican Republic, *Liebman!* (v. s. in Herb. T. C. D.)

Stem short, with a few lateral branches. *Branches* 1-2 inches long, laxly clothed below, very densely set above with short pinnato-multifid ramuli one or two lines in length; the lowest of which are shortest and subsimply pinnate, the upper longer and more compound, their pinnules once or twice forked or irregularly multifid. *Tubes* about twelve in the stem. *Colour* under the microscope a dull brown. *Substance* rigid. It does not adhere to paper in drying.

27. Polysiphonia *thyrsigera*, J. Ag.; "two inches high, tufted, becoming very black in drying, rigid; branches setaceous, virgate, above densely clothed with curved acute, cymose or racemose, tetraspore-bearing ramuli (Carpoclonia, Kütz.); internodes of the branches thrice as short as broad, ten-tubed, of the fruit-bearing ramuli twice as short." *Kütz. Sp. Alg. p.* 838.

Hab. La Guayra, Mexico, *Liebman.*

I have not seen this plant, for which I adopt Kützing's description, slightly altered.

27. Polysiphonia *verticillata*, Harv.; filaments short, creeping, setaceous, sparingly branched; branches erect, densely beset on all sides with simple, incurved, acute ramuli; articulations many-tubed, much shorter than their diameter in the branches, rarely as long as broad in the ramuli; tubes ten or twelve. *Harv. in Bot. Beechey, p.* 165 *Kütz. Sp. Alg. p.* 839.

Hab. California, *Capt. Beechey.* (v. s. frustulum in Herb. T. C. D.)

One to two inches high, with the aspect of a *Cladostephus*, or perhaps more nearly resembling *Rhodomela larix* in miniature. The ramuli, though very densely set on all sides, imbricate, and crowded round the ends of the branches, are scattered, not whorled. The articulations are on a close examination clearly visible in the branches as well as the ramuli, but, owing to the opacity of the substance, only after long steeping the dry plant. The internodes are uniformly very short, the tubes broad.

I regret that I can throw little additional light on this imperfectly known plant, of which I possess merely one or two minute fragments. These are different from any North American specimens I have seen, but seem nearly allied to *P. dictyurus.* The specific name *verticillata* conveys an incorrect idea.

28. Polysiphonia *fastigiata*, Grev. ; tufts globular, fastigiate; filaments rigid, setaceous, of nearly equal diameter throughout, many times dichotomous ; axils patent ; internodes shorter than their diameter, many-tubed, with a dark central spot ; tubes sixteen to eighteen. *Ag. Sp. Alg. Vol.* 2, *p.* 67. *Kütz. Sp. Alg. p.* 809. *Harv. Phyc. Brit. t.* 299. *Conferva polymorpha*, *Linn. Dillw. Conf. t.* 44. *E. Bot. t.* 1764.

Hab. Parasitical on *Fucus nodosus and F. vesiculosus.* Common on the East Coast from Halifax to New York. Golden Gate, California, *Capt. Pike*, (v. v.)

Tufts globose, one or two inches in diameter, dense. *Filaments* rigid, dark-brown, excessively branched from the base, the main branches and their primary divisions dichotomous, with wide axils, the ramuli less regular in ramification, and often alternately multifid. All the apices are of nearly the same length, giving the tuft an appearance of having been clipped all round like a thorn bush. The internodes frequently show, besides their longitudinal bands, a dark central spot, which is the coloured bag of the axial cell seen through the outer walls. *Conceptacles* ovate, somewhat acuminate, sessile near the ends of the branches, often two or more close together.

This species, though named *polymorpha* by the earlier writers on Algæ, is very constant to its characters, and if once seen, can hardly be mistaken for any other. It is very constantly found on *Fucus nodosus*, wherever that common littoral plant grows ; and more rarely on *F. vesiculosus.* Capt. Pike's specimens from the Pacific coast are identical with Atlantic-grown individuals.

IX. BOSTRYCHIA, *Mont.*

Frond dull purple, filiform, branched, inarticulate (or sub-articulate with very

short internodes), tessellated with quadrate cells ; axis tubular, articulated, surrounded by one or more concentric series of oblong coloured cells, which are successively shorter toward the circumference ; surface cells quadrate. Ultimate *ramuli* frequently monosiphonous. *Conceptacles* ovate, terminal, containing a tuft of pear-shaped spores. *Tetraspores* contained in fusiform, terminal stichidia, in a double row.

A very natural and now pretty extensive genus, consisting of small Algæ of similarly amphibious habits, and all of a dull, blackish or livid purple colour. It is difficult to distinguish some of them by a definite character from *Dasya*, and others from *Polysiphonia* ; others again have been placed in *Rhodomela*. They rarely grow in the open sea. Their favourite localities are near high water mark, often in places where they are seldom submerged, or in brackish water, as the estuaries of rivers ; and some grow even in perfectly fresh water, in mountain streams far removed from the sea. The same species, as in the case of *B. vaga* of Kerguelen's Land, may occasionally be traced from the rocks and stones about high water mark, to a considerable distance inland.

The typical species are inarticulate, but are beautifully dotted with large square cells arranged in transverse lines, several cells in each band. Such transverse bands are evidently of the same nature as the many-tubed internodes or articulations of *Polysiphonia*, the difference being one of degree, and not of kind, and consisting in the very short and minute cells of the *Bostrychia* compared to the elongated tubular cells of the *Polysiphonia*. In other species, as our *B. rivularis*, the cells of the stem are longer, and the ramuli are almost articulated, the lower parts pluri-striate, their ends unipunctate or monosiphonous. Yet this species cannot be naturally separated from *B. radicans*, *B. Hookeri*, &c. which are of the typical structure ; nor yet again, as I think, from *B. Toumeyi*, which, were there no such connecting links, would probably be placed in *Dasya*. Again, *B. calamistrata* is in all respects, except in the structure of its ramuli, an orthodox species of *Bostrychia ;* but by these single-celled ramuli it is associated with the aberrant *B. Toumeyi*.

Sub-genus 1. Eubostrychia. Peripheric cells in several concentric rows (as seen in a cross section of the stem).

1. Bostrychia *Montagnei* ; frond ultrasetaceous, opaque ; main stems three or four times pinnated, strongly reflexed or arching backwards ; pinnæ distichous, close together, horizontally patent, recurved, the terminal ones often secund ; pinnules capillary, pinnulate or bipinnulate, dotted, inarticulate, their tips alone unipunctate, surface cells quadrate ; apices inflexed ; stichidia elongate, acuminate. (Tab. XIV. B.)

Hab. On the mangrove stems, at high water mark. Key West, *W. H. H.* Bahia Honda, *Prof. Tuomey* (9). (v. v.)

Fronds in large, bushy tufts, three to four inches long. *Stems* thicker than hog's bristle, gradually attenuated upwards, undivided, strongly arched or deflected backwards; in the lower half, generally thorny with the remains of broken branches set one to two lines apart; in the upper half, closely et with distichous, alternate, nearly horizontal branches. *Branches* bi-tripinnate, the lowermost shorter and less compound, the middle ones longest, the upper short and usually bent in pairs to one side, and thus (falsely) secund. *Stems* and *ramuli* opaque, inarticulate; the stems dotted with many rows of small, quadrate, pellucid-bordered cells, the ramuli dotted with similar but fewer cells, and the extreme tips consisting of a single row of cells. A cross section of the stem shows a minute central cavity surrounded by many rows of small cells, each containing a small purple endochrome. I have not seen conceptacles. *Stichidia* are common, and are formed in the ramuli; they are linear-lanceolate and acuminate and contain a double row of tetraspores. *Colour* a brownish purple, varying in intensity. *Substance* rigid. The plant does not adhere to paper in drying.

This forms large tufts on the stems of mangrove trees at various places near Key West, and probably occurs in similar situations among the other reefs and keys. It invests the stems up to the very limit of high water mark, and is consequently left dry for many hours each tide; and then strongly resembles collapsed fronds of *Hymenophyllum Tunbridgense*.

The specific name is imposed in honour of Dr. Camille Montagne of Paris, the well known author of many works on Cryptogamia, and who first defined this genus. *B. Montagnei* is one of the largest and handsomest species with which I am acquainted, and I have much pleasure in dedicating it to my learned friend.

Specimens of a strangely metamorphosed variety of this plant, said to have been collected at Valparaiso, have been communicated to me by Mrs. Tyers of Bristol (England). In this variety or monstrosity, several of the secondary branches (or primary pinnæ) are resolved into a system of capillary, subdichotomous, excessively divided branches, two to three inches long. This completely alters the aspect of the plant, and these feathery specimens might pass for a different species, were it not that, on the same stem, some branches retain their proper character.

Plate XIV. B. *Fig.* 1. Bostrychia *Montagnei*, the *natural* size. *Fig.* 2. portion of a branch, with pinnæ; *fig* 3, a pinnule and a stichidium, on opposite sides of the branchlet; *fig.* 4, transverse section of the stem; more or less highly *magnified*.

2. Bostrychia *calamistrata*, Mont.; stem subcompressed, inarticulate, dotted, alternately branched; branches distichous, subhorizontally patent, oblong, circumscribed, bi-tripinnate; pinnæ closely set, dotted; pinnulæ capillary, multifid, involute, articulate, single-tubed; articulations rather longer than broad; conceptacles ovate, terminating the dotted pinnæ; stichidia similarly placed (on different individuals) spindle shaped, incurved. *Mont. Nat. Hist. Cuba, p.* 36, *t.* 4, *fig.* 1. *Harv. Ner. Austr. p.* 68. (var. *repens*). (Tab. XIV. C.)

Hab. On mangrove stems, and on logs about the wharf, at Key West, *W. H. H.* (No. 7). Pine Island, *Prof. Tuomey* (10[b].) (v. v.)

Stems 1-2 inches high, as thick as hog's bristle, alternately branched; branches an inch long, horizontally patent, simple or once or twice divided, distichous, closely bi-tri-pinnate. The lower parts of the stem are generally beset with short, spine-like, broken branches, the remains of earlier growth; the upper parts, as well as the main branches and their divisions, closely beset with very slender, alternate, patent, simple or multifid, inflexed or involute, capillary ramuli. The stems and branches and the primary pinnæ are solid, inarticulate, and dotted with quadrate cells; the pinnulæ and their divisions articulate, formed of a single series of oblong cells, once and half or twice as long as broad. A cross section of the stem shows a small central cavity surrounded by numerous rows of coloured cells. *Conceptacles* ovate, terminating the primary pinnæ, containing a tuft of pear-shaped spores. *Stichidia* spindle shaped, terminal, curved, acuminate. *Colour* a brownish purple. *Substance* cartilaginous, rigid. It does not adhere to paper.

Our specimens agree with those received by Dr. Montagne from Cuba. They differ from the plant described in *Harv. Ner. Austr.* as above quoted, in being erect, and destitute of root-like discs.

Plate XIV. C. *Fig.* 1. Bostrychia *calamistrata*, the *natural* size. *Fig.* 2, apex of a branch, with conceptacles; *fig.* 3, a conceptacle and ramulus; *fig.* 4, spores; *fig.* 5, small portions of the ramulus; *fig.* 6, cross section of the stem; *fig.* 7, a stichidium; all more or less highly *magnified.*

Sub-genus 2. Stictosiphonia. Peripheric cells in a single row

3. Bostrychia *rivularis;* stems an inch high, rising from creeping filaments, capillary, bipinnate; pinnæ distichous, alternate, patent, inarticulate, tessellated with subquadrate cells; pinnulæ subdistant, simple or forked, attenuate, marked with about two rows of oblong cells; peripheric cells seven or eight; conceptacles ovate, terminating the lowest pinnæ, which are then abbreviated and bare of pinnules. (Tab. XIV. D.)

Hab. Isle of Shoals, *Mr. Pike.* Hellgate, New York, *Mr. Hooper.* On *Spartina glabra*, and on the Palmetto logs in the Ashley and Cooper Rivers, Charleston, *Prof. Bailey and W. H. H.*, also found by *Prof. Bailey* in the St. John's River, Florida. (v. v.)

Fronds an inch high or less, slender, spreading over the logs in wide patches, rising from a mat of creeping fibres, attached here and there by discs. *Stems* somewhat flexuous, erect, pinnate or bipinnate, or in luxuriant specimens sub-tripinnate. *Pinnæ* alternate, distant, spreading, laxly pinnulate. *Pinnulæ* also patent, subulate, sometimes again compounded. The whole frond is tessellated with quadrate or oblong cells arranged in longitudinal rows, the ramuli having about two rows, the larger

divisions three or four. A cross section of the stem shows seven or eight cells surrounding a central cavity. *Conceptacles* borne on the ends of shortened branches. I have not seen stichidia. *Colour* a dull brownish purple. *Substance* rigid. It does not adhere to paper in drying.

This plant is abundant in estuaries of rivers in Carolina and Florida, and probably in other Southern States. The only other specimens I have seen were given me by Capt. Pike of Brooklyn, having been collected by him in July, 1848, at the Isle of Shoals (lat. 43°); and by Mr. Hooper, collected at the estuary of the Hudson. I have not heard under what circumstances Capt. Pike's plant grew, whether in open sea or estuary. There is no appreciable difference in ramification between it and the Carolinian specimens.

Plate XIV. D. *Fig.* 1. Bostrychia *rivularis*, growing on a piece of wood; the *natural* size. *Fig.* 2, two erect stems, rising from a creeping filament; *fig.* 3, pinna and portion of a stem; *fig.* 4, cross section of the stem; *fig.* 5, conceptacle; all *magnified.*

4. Bostrychia *Tuomeyi*; frond capillary (small), irregularly divided; branches erecto-patent, not much branched, articulato-tessellate, four-tubed and subquadrangular, rough with broken ramuli below, densely clothed with very slender, inflexed, alternately branched, single tubed ramuli above; cells of the ramuli once and half to twice as long as broad. (Tab. XIV. E.)

Hab. On rocks. Pine Islands, Florida, *Prof. Tuomey.* (10). (v. s. in Herb. T. C. D.)

Fronds tufted, about inch and half high, capillary, irregularly divided into numerous, erecto-patent, simple or forked branches. Lower part of the stem and branches naked, or beset with the spine-like remains of broken ramuli; the upper and younger parts densely clothed with inflexed, very slender, slightly branched ramuli. The stem and branches are tetrasiphonous, four large coloured cells surrounding a central cell; and when viewed laterally appear articulate, the internodes shorter than their breadth and marked with three tubes. The *ramuli* are formed of a single string of cells. *Colour* a dark lurid purple. *Substance* rather soft. In drying, it adheres pretty firmly to paper.

I have seen no fructification, and the generic relations are therefore at present doubtful, the structure of the frond being that of a *Polysiphonia* with very short internodes. Still it seems to me to range naturally in the present group, from the other species of which it chiefly differs in having very few (four) cells in the peripheric stratum. The ramuli are of precisely the same structure as those of *B. calamistrata*, and the colour is that blackish purple so characteristic of this genus.

I bestow the specific name in compliment to Prof. Tuomey, of the University of Alabama, to whom I am indebted for an interesting collection of Floridan Algæ.

Tab. XIV. E. *Fig.* 1, Bostrychia *Tuomeyi*; the *natural* size. *Fig.* 2, apex of a branch; *fig.* 3, small portion of a branch, to show the cellular structure; *fig.* 4, cross section of the same; *fig.* 5, a ramellus; *fig.* 6, small portion of the same; all more or less highly *magnified.*

X. DASYA. *Ag.*

Frond filiform or compressed, branching, opaque or rarely articulated, having a polysiphonous, articulate axis, coated externally with accessory cells. *Branches* beset with, or resolved at their ends into slender, single-tubed, confervoid, articulate ramelli. *Conceptacles* ovate, acuminate, sessile or pedicellate, affixed to the compound branches, and containing a tuft of pear-shaped spores. *Tetraspores* in lanceolate stichidia (or transversely banded, pod-like receptacles) formed on the confervoid ramelli.

A large and considerably diversified genus, occurring in both hemispheres. As here understood, it is chiefly characterised by the confervoid, jointed ramelli, issuing from a compound, polysiphonous, but mostly opaque and outwardly inarticulate frond; and the lanceolate, pod-like receptacles of tetraspores, borne by the confervoid ramelli, out of whose branches they are formed. The ramelli are of the same structure as the articulated fibres which clothe the ends of the young branches in *Polysiphonia*, *Rhodomela*, etc. but in those genera they are mostly colourless, very fugacious, and have no connection with the tetrasporic fructification; in *Dasya*, on the contrary, they are persistent, containing coloured cells, and finally originating the tetrasporic fructification. In the former cases they accompany the early development of the branches only, in the latter they are characteristic of the species at all ages. In *Bostrychia* the stichidia are borne by the compound branches, and in *Polysiphonia* the tetraspores are dispersed through slightly modified and distorted polysiphonous ramuli.

In the Nereis Australis (p. 58) I have grouped the species under five subgenera, four of which are represented on the North American coasts: viz.

Subgenus 1. *Compsoteia.—*Frond* more or less distinctly articulated, especially in the upper branches, decompound-pinnate, distichous; the lesser branches dichotomous, resolved at the apices into dichotomo-multifid, confervoid ramelli.

1. Dasya (Compsoteia) *Gibbesii*; stem compressed, areolate, inarticulate, with a central line of short, transverse striæ (nodes of the axial tube), distichously branched, decompound-pinnate; branches bi-tripinnate, with an obovate outline; pinnules subarticulate, dichotomous, their terminal divisions resolved into dichotomous, single-tubed, fastigiate, confervoid ramelli; articulations of the ramelli twice

* This subgenus (misspelled *Campsotela*) is strangely misunderstood by Kützing in his "Species Algarum," p. 797—only two out of the fifteen species which he enumerates agreeing with the character. His first species is a *Callithamnion*; his 3rd, 5th, 10th, are *Rhodonemata*; his 9th a *Wrangelia*; his 11th, a *Stichocarpus*; 12th, a *Lophothalia*; and 14th and 15th, *Bostrychiæ*. The name given to this uncombed assemblage is *Eupogonium*.

as long as broad ; apices bluntish ; stichidia lanceolate-acuminate, on the lower forks of the ramelli. *Polysiphonia Gibbesii, Harv. MSS. in Herb. Gibbes.* (Tab. XV. A.)

Hab. At Key West, abundant. *Dr. Wurdeman, Prof. Tuomey* (27), *W. H. H.* (8), &c. (v. v.)

Root a small disc. *Fronds* tufted, 4-8 inches high, half a line to nearly a line in diameter in the middle, and tapering to the base and apex, distichously much branched. *Stem* undivided, slightly zigzag, naked for an inch or more above the base, thence upwards furnished at intervals of about half an inch with several alternate branches, much narrower than the part from whence they spring, the lower ones long, and again compounded, the upper gradually shorter. *Branches* in circumscription obovate, fastigiate, round-topped, twice or thrice pinnated ; the pinnules dichotomous, with rounded angles, their ultimate divisions resolved into single-tubed, many times dichotomous ramelli. The stem and branches are compressed, coated with polygonal cells, inarticulate, with a medial row of minute dark coloured, transverse lines, a quarter of a line apart and visible to the naked eye, or with a pocket lens. These lines are the nodes of the central tube of the axis of the frond. The pinnules are cylindrical and articulate, polysiphonous and somewhat veiny in their lower parts, few-tubed in the upper, and at length passing into the single-tubed ramelli. The *stichidia* are numerous on the lower forks of the ramelli ; several on the same ramellus ; they are pedicellate, oblongo-lanceolate, acuminate, and contain a triple series of large tetraspores. *Conceptacles* unknown. *Colour* a purplish lake, growing darker and browner in drying. *Substance* of the stem and branches cartilaginous, of the ramelli soft and tender. In drying, the plant adheres pretty firmly to paper.

A beautiful species, unlike any other North American one, but allied to *D. Gunniana* and *D. Lawrenciana* of Tasmania, from both which, however, it is abundantly distinct. The name is given in honour of Prof. Lewis R. Gibbes of Charleston, from whom I received the first specimen of this and several other interesting Algæ of Florida.

Plate XV. A. *Fig.* 1. Dasya *Gibbesii* ; the *natural* size. *Fig.* 2, apex of a lesser branch with terminal ramelli and stichidia ; *fig.* 3, a stichidium ; *fig.* 4, a tetraspore ; *fig.* 5, portion of a ramellus ; *fig.* 6, part of the stem, to show surface cellules, and medial, dark striæ ; *fig.* 7, longitudinal section of the same through the smaller diameter ; *fig.* 8, transverse section ; all more or less *magnified.*

Subgenus 2. Rhodonema. *Frond* inarticulate or rarely articulate, cylindrical, irregularly branched ; branches more or less completely clothed on all sides with dichotomous, single-tubed, confervoid ramelli. *Stichidia* glabrous.

2. Dasya (Rhodonema) *elegans*, Ag.; frond very soft and flaccid, soon decomposing ; stem robust, inarticulate, elongate, alternately decompound ; branches filiform, of unequal length, undivided, all the younger parts clothed with byssoid,

purple-lake, dichotomous ramelli ; articulations of the ramelli many times longer than broad ; conceptacles urnshaped, on long pedicels, rising from the branches ; stichidia linear-lanceolate. *Ag. Sp. Alg.* 2, *p.* 117. *Kütz. Sp. Alg. p.* 796. *Rhodonema elegans, Mert.*

Hab. Growing on other Algæ, on woodwork, rocks, &c. from low water mark to the depth of several fathoms. Annual. Nantucket, *Dr. Durkee.* Greenport. Providence, *Prof. Bailey and Mr. Olney.* Very common in New York Harbour from Hellgate to Red Hook, *Messrs. Bailey, Hooper, Walters, Pike, Congdon, Calverley, &c.* Charleston, *Prof. Gibbes, W. H. H.* Key West, *Prof. Tuomey, Dr. Blodgett, W. H. H.* (v. v.)

Root discoid. *Stems* from six inches to one, two, or three feet long, varying in diameter from the thickness of hog's bristle to that of a crowquill, or in the larger specimens from one to two lines in diameter, softly cartilaginous when quite fresh, but soon becoming very flaccid, either quite simple or divided below into a few secondary stems, and set throughout the whole length with numerous lateral branches, spreading on all sides. The branches are very irregularly placed, sometimes widely scattered, sometimes densely crowded ; alternate or subopposite, or even fascicled ; they are simple, patent, virgate, either destitute of lesser branches, or furnished with very numerous, short lateral branches, so that the general frond is sometimes but slightly divided and sometimes very bushy. All the larger and smaller branches and the main stem when young are densely clothed with exceedingly slender, bright purple, soft, confervoid ramelli. These *ramelli* are from two to four lines long, dichotomous, a few times distantly forked, with the terminal laciniæ very long and filiform, but not tapering to the apex ; the apical cell being very blunt. The articulations of these ramelli are of great length. *Conceptacles* abundantly scattered along the branches, on long stalks. *Stichidia* attached to the ramelli, one or more on each ramellus near its base, very slender, lanceolate, acuminate, containing a double or triple row of tetraspores. *Colour* in all parts a brilliant purple lake, well preserved in drying. *Substance* soon decomposing in fresh water. In drying, the plant adheres most closely to paper.

There are two principal forms ; one, which grows in deep water, has very long simple branches, destitute of laterals ; the other, which grows within tide marks, is short and bushy, with abundant secondary branches. The European forms of this plant do not essentially differ.

3. Dasya (Rhodonema) *ramosissima* ; stem cartilaginous, tough, inarticulate, robust, attenuated and flaccid upwards, much branched ; branches several times alternately decompound, denudate ; ultimate divisions setaceous, subarticulate, more or less completely clothed with dichotomous ramelli ; their apices incurved, attenuate ; articulations three to five times as long as broad. Var. *a* ; frond naked, except the tips of the ultimate branches, which are crowned with a dense tuft of

ramelli. Var. β. more densely branched and bushy, with shorter branches, and more diffused, more copious, and much attenuated ramelli.

Hab. At Key West, *W. H. H.* (9, 10). (v. v.)

Frond six to twelve inches long or more, as thick as sparrow's quill below, much attenuated upwards, divided near the base into several principal branches or stems, which are excessively decompound and bushy ; each set of lesser branches springing along the sides of the primary branches irregularly. The ultimate branches are from half an inch to an inch long, not so thick as hog's bristle, imperfectly jointed, the internodes areolated with irregularly formed cells, and about as long as broad ; they are sometimes naked except at the extremity, but are more usually clothed beyond the middle with densely crowded ramelli. These ramelli are from a quarter line to a line in length, of much greater diameter than those of *D. elegans*, erectopatent, dichotomous, their divisions generally arched inwards and tapering to a point. The axils are all narrow. The articulations very variable in different individuals, sometimes only about as long as broad, sometimes 3-5 times as long. A cross section of a small branch shows five primary tubes, surrounded by numerous external cells, smaller to the circumference : in the larger branches and stem the external border of cells is proportionably thicker and denser. I have only seen immature *stichidia* ; they are linear oblong, and subacute, on the first or second forks of the ramelli. *Colour* a brownish red or purplish brown, becoming much darker in drying. *Substance* tough and tenacious, but very soft. This plant bears immersion in fresh water for some time without injury, and in drying adheres strongly to paper.

4. Dasya (Rhodonema) *mollis* ; robust, very soft and flaccid, alternately much branched, bushy ; branches inarticulate, twice or thrice compounded, their ultimate divisions short ; all the younger parts clothed with confervoid ramelli which are laxly scattered on the larger and densely imbricated on the smaller branches ; ramelli patent, dichotomous, from a robust base much attenuated, and very slender ; axils wide ; lower articulations short and cellular, upper four to six times as long as broad, single tubed ; stichidia oblong-acuminate.

Hab. Key West, rare. *W. H. H.* (14). (v. v.)

Frond 2-3 inches high, as thick as sparrow's quill, irregularly much branched, bushy, often wider in the spread of the branches than the height of the stem. The stem in my specimens divides a short distance above the base into three or four main divisions, which spread subhorizontally, fork irregularly, and are decompoundly once or twice divided : the branches alternate, or irregular, of unequal length, long and short indiscriminately mixed. All the branches and their divisions are hirsute with squarrose, patent ramelli, laxly scattered over the older

parts, crowded on the younger, and very dense toward the extremities. These ramelli are about a quarter of a line long, their lower forkings much thicker than the upper, which are rather suddenly attenuated and very slender, the terminal divisions much prolonged. The lower articulations of the ramelli are about as long as broad, sub-opaque and multicellular; the upper cylindrical, 4-6 times as long as broad. A cross section of the stem shows five large primary tubes and five alternate secondaries, surrounded by small cells. *Stichidia* near the base of the ramelli, one on each, subsessile, oblong-acuminate, very acute, containing a triple row of tetraspores. *Substance* exceedingly soft and tender. *Colour* pale red, rosy toward the tips. It closely adheres to paper.

A smaller plant than *D. ramosissima*, with more slender ramelli. The external habit and the substance are more those of a *Dudresnaia* than of a *Dasya*.

5. Dasya (Rhodonema) *mucronata* ; robust, elongate, cartilaginous, inarticulate, decompound ; branches several times alternately divided, denudate, their extremities and the smaller branches densely clothed with squarrose, rigid, confervoid ramelli ; ramelli robust, patent, dichotomous, their axils wide and divisions divaricating, their apices remarkably mucronate ; articulations twice as long as broad, dissepiments slightly contracted.

Hab. Abundant at Key West, *W. H. H.* (11). (v. v.)

Root a spreading disc, sometimes half an inch in diameter. *Stems* one or more from the same base, six to eight inches long or more, as thick as crowquill below, attenuated upwards, simple or once or twice divided, bare of branches for an inch or two above the base ; thence upwards furnished with numerous scattered or crowded, alternate or irregular lateral branches. These branches are about as thick as hog's bristle, 4-5 inches long, the lowest longest, and are furnished with one, two, three, or more series of similar lateral branches, all of which spread at wide angles ; the penultimate ones short. The larger branches are generally denuded in full grown plants, but all the younger portions are clothed on all sides with ramelli, which are particularly dense toward the extremities. These *ramelli* are scarcely half a line long, rather rigid, standing on the branches at right angles, and are many times regularly dichotomous, with divaricating branches. The terminal cell of each segment of the ramellus is very small, subulate and acute, forming a mere *mucro* to the large oblong cell immediately below it. The articulations are uniformly about twice as long as broad. A transverse section of a branch shows five large primary tubes, surrounded by a wide band of small cells. The colour of the stem and branches is a dull brownish red, of the ramelli brighter and more rosy. The *substance* is firmer and more rigid than in most others of this genus. In drying, it does not adhere strongly to paper.

This species is frequently infested by parasites. It is one of the largest and coarsest of the subgenus, and readily known, on microscopic examination, by the mucronate ramelli.

6. Dasya (Rhodonema) *Wurdemanni*, Bail. ; capillary, of small size, (an inch high), once or twice forked ; secondary branches alternate or secund, arched, articulate, hirsute with squarrose ramelli ; ramelli very patent, many times dichotomous, sub-rigid, their divisions divaricating, apices acute, articulations once or twice as long as broad. (Tab. XV. C.) var. *β. dichotoma ;* more regularly dichotomous, with shorter and straighter secondary branches.

Hab. Abundant on Algæ and corals, at Key West. *Dr. Wurdeman, W. H. H.* (15). (v. v.)

This forms small, roundish, dense, fastigiate tufts, or often is entangled among the branches of the Algæ which it infests.

The *stems* are an inch or two high, about as thick as coarse human hair, once or twice forked, and then alternately or secundly branched. The secondary branches are very frequently secund, erect, arching inwards, with the ends inrolled, and are beset throughout with ramelli which are short and subdistant below, gradually longer and more densely set above, and also longer and more numerous on the outer than on the inner side of the curved branch. These ramelli stand almost at right angles on the branch, are several times forked, with very wide axils and divaricated segments, and their articulations are seldom more than twice as long as broad. The stem and branches are obviously jointed, the internodes few-tubed with pellucid nodes, but I have not been able to determine the number of tubes, whether four or five, owing to the very imperfect absorbent powers of the dried cells. The *colour* is a dull red, inclining to brown. The *substance* is somewhat rigid, not at all lubricous. In drying, the plant adheres pretty firmly to paper.

β. is a little different in aspect, the stem being more regularly dichotomous, the secondary branches shorter and straighter, and the ramelli more equally distributed. It somewhat resembles some weak-growing forms of *D. arbuscula*, to which *D. Wurdemanni* is certainly allied, although perfectly distinct.

The specific name was bestowed by Prof. Bailey in honour of the late Dr. Wurdeman, who first detected this curious little species, and to whom we are indebted for an interesting series of Key West Algæ.

Plate XV. C. *Fig.* 1, Dasya *Wurdemanni;* the *natural* size. *Fig.* 2, some branches; *fig.* 3, portion of a branch, with ramellus; the latter figures *magnified.*

Subgenus 3. Lophothalia. *Frond* articulate or opaque, four-tubed, virgate, alternately branched ; branches naked or clothed with simple or pinnated, single tubed, confervoid ramelli. *Stichidia* rising from the branches, hirsute with ramelli.

7. Dasya (Lophothalia) *Tumanowiczi*, Gatty; stem cartilaginous, opaque, robust, attenuated upwards, alternately decompound; branches elongate, setaceous, their divisions capillary, set with short spine-like branchlets, and imperfectly articulated; internodes once and half as long as broad, coated with polygonal cells;

branchlets articulate; ramelli few, near the ends of the branches, sub-simple or pinnate; stichidia lanceolate, clothed with ramelli (formed in the rachis of a pinnated ramellus). *D. chordalis*, *Harv. in Herb.*

Hab. Key West, *W. H. H.* (12), *Dr. Blodgett* (59 and 75). West Indies, *Mr. Tumanowicz.* (v. v.)

Root scutate, with lateral, branching fibres. *Stem* 6—12 inches long or more, as thick as sparrow's quill at base, tapering upwards and capillary above, cartilaginous and tough below, very flaccid above, much branched; dividing near the base into several principal branches or secondary stems, which are repeatedly compound in an irregularly pinnate manner. The primary division sometimes, from repeated suppression of parts, appears dichotomous; sometimes several of the secondary branches are secund, and in other specimens crowded together and almost tufted. The secondary branches are about as thick as hog's bristle, several inches long, simple or having a second or third series of similar thread-like branches, beset at short intervals with minute, spine-like, subulate ramuli. These latter are readily seen with the help of a pocket lens, but not very obvious without one, and are articulate, each consisting of four or six four-tubed internodes of equal length and breadth. The main stem and larger branches are opaque, coated with irregular cells; the younger branches imperfectly jointed, the internodes areolated with irregular polygonal cells, and about once and half as long as broad. A transverse section of a small branch shows four primary and four alternate secondary tubes, and about eight small superficial cells; a section of the stem still exhibits the four primary tubes, but the external coat is very wide and dense. Single tubed *ramelli* are irregularly scattered on the younger parts of the branches, as well as on the spine-like ramuli, from whose axils they often issue; they are slender, pinnate, sometimes bi-tri-pinnate, the pinnæ very erect; and the articulations 3-4 times as long as broad. *Stichidia* are formed from the swelling of the upper portion of the rachis (or jugament) of these ramelli, and are densely clothed with the pinnules; they are moniliform, and contain a string of tetraspores. When the transformation is incomplete, the stichidium appears as if borne on the end of the rachis, but sometimes almost the whole ramellus is converted into fructification. *Colour* a fine clear red. *Substance* tough but soft. In drying, the plant adheres closely to paper.

I have received a West Indian specimen of this plant from Mrs. Gatty, at whose request I give it the name of the gentleman from whom she received it, Mr. Tumanowicz, a Pole now resident in England, and a most ardent student of marine botany. I believe I have already distributed some specimens under the MSS. name *chordalis*, which I now lay aside.

8. Dasya (Lophothalia ?) *lophoclados*, Mont.; stem setaceous, irregularly dichotomous, sub-articulate; branches divaricating, decompound, their ultimate divisions articulate; all the younger parts of the frond densely clothed with sparingly

branched, alternately divided, straight, hairlike ramelli; internodes of the stem about once and half as long as broad, of the ramelli many times longer than their diameter; fruit unknown. *Mont. An. Sc. Nat.* 1842, *p.* 254. *Polysiphonia lophoclados*, *Kütz. Sp. Alg. p.* 834.

Hab. Floating in the sea near Key West, *Prof. M. Tuomey* (No. 6). (v. s. in Herb. T. C. D.)

Stems 3-4 inches long or more, as thick as hog's bristle, attenuated upwards, several times irregularly forked, the divisions widely spreading with very obtuse angles, the lesser branches more and more irregularly forked, the ultimate ones alternately divided. The lower parts of the stem are subopaque; the larger branches generally exhibit more or less definite veiny internodes, and the smaller branches are clearly articulate, their internodes once and half as long as broad, thinly coated with minute cells. A cross section of a branch shows four large primary tubes, four secondaries and several external cells. The ramelli are very slender, about a line long, or a little longer, straight, erectopatent, spreading on all sides and abundantly clothing the lesser divisions of the frond; they are less frequent on the larger branches, and altogether wanting in the lower parts. They are not much branched, between alternately pinnate and dichotomous, their branches simple, very long and straight. The articulations toward the base of the ramellus are twice or thrice as long as broad, in the middle part 8-10 times their diameter. The colour of the stem is brownish, that of the ramelli a purple lake, browner in drying and greenish in decay. The substance is soft and delicate. In drying, it adheres closely to paper.

I have compared my specimen with a fragment of Dr. Montagne's Haytian one, and they seem of the same species. The fruit is not known, but the habit is that of *Lophothalia*, and should this subgenus ever rank as a genus, this species ought to be called *L. Montagnei*.

Subgenus 4. Stichocarpus. *Frond* more or less obviously articulate, many-tubed, crimson-lake, decompound-pinnate, distichous, the ultimate pinnules (ramelli) single-tubed, simple, subulate.

9. Dasya (Stichocarpus) *plumosa*, Bail. and Harv.; frond inarticulate, compressed, two-edged, distichously bi-tripinnate; the pinnæ elongate, pinnules short, both alternate and densely beset with distichous, often opposite, straight, simple or forked, single-tubed ramelli; articulations of the ramelli thrice as long as broad. *Bail. and Harv. in Bot. Expl. Exped.*

Hab. Puget's Sound, *Capt. Wilkes.* (v. s. in Herb. Sm. Inst.)

A single imperfect specimen of this plant is all that I have seen. The fruit is unknown; the habit is that of a *Ptilota*, but a cross section of the stem shows the

structure peculiar to *Dasya*. The frond is probably several inches long, with an ovate outline, twice or thrice pinnate ; the pinnæ elongate, and pinnules short. Both pinnæ and pinnules are closely bordered with distichous, opposite, articulate, confervoid ramelli. *Colour* a clear carmine.

Order II.—LAURENCIACEÆ.

Harv. Man. Br. Alg. Ed. 2, *p.* 95. *Laurencieæ, Hook. fil. and Harv. Lond. Journ. vol. IV. p.* 539. *Chondrieæ in part J. Ag. Alg. Medit. p.* 67. *Harv. Ner. Austr. p.* 75. *J. Ag. Sp. Alg. vol.* 2, *Syn. p. x. Lomentarieæ, Endl.* 3*d Suppl. p.* 42. *Mont. Pol. Sud. Crypt. p.* 122. *Part of Chondrieæ, Chondrosipheæ and Champieæ, Kütz. Phyc. Gen. pp.* 435, 438, 439. *Part of Chondrieæ, Champieæ and Polysiphonieæ, Kütz. Sp. Alg. pp.* 849, 861, 842. *Lomentarieæ* (*partly*), *Lindl. Veg. Kingd. p.* 25.

Diagnosis. Rose-red or purple seaweeds with a terete or compressed, rarely flattened, inarticulate or constricted and chambered branching frond composed of polygonal cellules. *Sporiferous-nucleus* contained in external, ovate or globose conceptacles ; *spores* pearshaped or obconical, subsessile or formed in the terminal cells of unbranched or paniculate, tufted spore-threads. *Tetraspores* immersed in the branches and ramuli of the frond, scattered without order among the surface cells.

Natural Character. *Root* either a simple disc, or a mat of branching fibres. *Frond* mostly terete, rarely compressed, more rarely flattened, mostly destitute of midrib, preserving nearly the same breadth throughout, decompoundly branched ; the branches generally repeatedly pinnated, opposite or alternate, rarely whorled or tufted ; sometimes, but very rarely, dichotomous. In the first suborder the frond is solid, inarticulate and opaque, of a firmly cartilaginous substance, wholly composed of polygonal cells packed together round a central cell into a honeycombed structure, the innermost cells being largest, those towards the surface gradually smaller, and the superficial very minute. Sometimes the axial cells form an articulated single-tubed axis ; and sometimes several longitudinal filaments run through the centre of the stem, like an immersed rib. In the second suborder the branches at least are hollow, constricted at intervals, and furnished at the constrictions with transverse diaphragms which divide the cavity into separate chambers, filled with a watery mucus, through which a few confervoid filaments, connecting the diaphragms are dispersed.

The *conceptacles* are of two forms, either globose and destitute of pore, bursting open at maturity ; or ovate, furnished with a terminal pore through which the ripe spores are discharged. These conceptacles are either formed in the hollowed apex

of abbreviated branches or ramuli, or they are sessile on the sides of the branches. Their *sporiferous nucleus* exhibits considerable modification in the different genera. In the *Bonnemaisonieæ* the spores are properly pear-shaped, rounded at the apex, and tapering at the base into a very slender spore-thread or funiculus of which the spore is the enlarged and fertile terminal cell. These spore-threads are always unbranched; in some species very short, in others long, and either rising in a tuft, from the base of the cavity, or from a cellular basal placenta, which occasionally fills up a considerable part of the cavity and is divided into several lobes. In the *Lomentarieæ* the spores are more properly obconical than pear-shaped, truncate at the apex and tapering but slightly at the base. In *Lomentaria* (*Chylocladia* of British writers, not of Agardh) where they taper most to the base, they are nearly sessile, radiating from a central point and closely packed together into a spherical nucleus. In *Champia* they are sometimes shortly obconical, and sometimes ellipsoidal or oblong, and are borne on a much-branched, confervoid placenta, each spore being formed in the terminal cell of one of the branches. Yet these two genera are so similar in aspect and in the structure of the frond that many species of the latter have by most authors been referred to the former.

The *tetraspores* (known only in *Laurencia*, *Lomentaria* and *Champia*) are *tripartite*, that is, formed of four pieces of unequal size so placed together that three only are visible on a front view, and are dispersed without order either through all the branches, or through the smaller ramuli, where, in some cases, they are collected in a sub-defined cluster near the apices. In this character is found the chief technical distinction between the *Bonnemaisonieæ* and the *Rhodomelaceæ*. The *Lomentarieæ* are additionally known by the peculiar structure of the frond and the differences, indicated above, in the sporiferous nucleus.

The colour of the frond in this order is considerably varied in the different genera, and even in the same species under different circumstances. *Bonnemaisonia*, *Delisia*, and *Asparagopsis* (*Lictoria*) are of a most beautiful rosy pink; *Lomentaria* and *Champia*, when in good order, are a purple lake, sometimes reflecting rainbow hues; but their colours are fugacious and, when the fronds grow in sunny places, they very frequently are either greenish, yellowish or nearly colourless. The proper colour in most *Laurenciæ* is a lurid purple, in some brown-red; but light and exposure in shallow water call forth every shade of red, orange and yellow, and sometimes green, the same frond often being variegated with two or more of these tints. Almost all decompose rapidly in fresh water, especially if again moistened after having once been dried.

The substance of the frond is either cartilaginous or gelatinoso-membranaceous. The taste insipid or somewhat pungent. *Laurencia pinnatifida*, the *Pepper Dulse* of the Scotch, was or is eaten as a salad in parts of Scotland (*Lightf. Fl. Scot. p.* 954). According to Dr. Lindley, a large portion of what is now sold in the shops as *Corsican Moss* is *Laurencia obtusa*, which perhaps has equal virtues with the real *Helminthochorton.*

This order, though small, is widely dispersed, being represented under one form or other in almost every sea. *Laurencia* is peculiarly cosmopolitan in its distribution, and its common forms, *L. pinnatifida*, *obtusa*, &c. are found in the most oppo-

site regions of the ocean of both hemispheres. *Champia* (as here understood) is equally sporadic. *Lomentaria ovalis* is a native of the Pacific and Atlantic oceans. *Bonnemaisonia* is European ; *Cladhymenia* and *Delisia*, Australian.

The natural limits of the order are variously understood by botanists, and I have the misfortune to differ from Prof. J. Agardh in my opinion on the subject. He admits two suborders, *Spongiocarpeæ* and *Solierieæ*, which do not appear to me to associate naturally with the other genera. *Spongiocarpeæ*, consisting of the remarkable genus *Polyides*, has a structure of frond and of fructification widely different from that of either of the suborders here retained, and also, in my judgment, from that of any other Desmiospermatous Order. The *Solierieæ*, consisting of *Solieria* and *Eucheuma*, appears to me to associate more naturally with *Hypnea*, and to connect that genus in some degree with *Gelidium*. I formerly admitted *Chrysymenia* and *Chylocladia*, J. Ag., and *Thysanocladia*, Endl. but the different structure of the nucleus in these genera, as has been well pointed out by Agardh, compels me to remove them elsewhere. Yet so similar in habit are some of the species of *Chylocladia* to some *Lomentariæ*, that almost all authors have confounded them. The presence of diaphragms in the frond is no certain test of a *Lomentaria*, as appears by *Chylocladia articulata*, whose sporiferous nucleus is identical with that of *Ch. clavellosa*.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

Suborder 1. Bonnemaisonieæ, J. Ag. *Frond* solid. *Conceptacles* ovate. *Spores* pear-shaped, on simple spore-threads.

I. Laurencia.

Suborder 2. Lomentarieæ. *Frond*, at least the branches, hollow, constricted at intervals and divided internally, by transverse septa, into chambers. *Conceptacles* ovate or spherical. *Spores* obconic or roundish, sessile, or attached to much branched, confervoid, spore-threads.

II. Champia. *Conceptacles* ovate, with a terminal pore. *Spores* paniculate, on branching spore-threads.

III. Lomentaria. *Conceptacles* globose, without a pore. *Spores* sessile, or nearly so, obconical.

I. LAURENCIA, *Lamour.* J. Ag. ref.

Frond solid, cartilaginous, terete or compressed, decompound pinnate, rarely subdichotomous, composed of two strata of cells : the medullary stratum of oblong-angular longitudinal cells, longest toward the centre of the stem ; the cortical of roundish angular cells in a subsimple row. *Conceptacles* ovate, with a terminal pore, containing within a cellular pericarp a dense tuft of pearshaped spores on simple funiculi radiating from a basal placenta. *Tetraspores* tripartite, lodged without order in a transverse band below the apices of the ultimate ramuli. *Antheridia* collected in terminal, saucer-shaped receptacles.

Fronds generally fleshy, rarely membranaceo-gelatinous when recent, cartilaginous when dry ; often livid purple, rarely a blood or rose-red colour, changing to greenish or yellowish when growing in shallow water exposed to sunshine. *Stem* and *branches* linear, terete or compressed, pinnately compound, the lesser divisions sometimes irregularly forked, or subdichotomous, distichous or branched to all sides ; the branches opposite, alternate or irregularly whorled ; sometimes very irregularly placed. *Ramuli* slightly constricted at the base, dilated and very obtuse at the summit ; the barren ones simply clavate, the fertile often by the development of rudimentary processes tuberculated or botryoid. *Conceptacles* formed from the transformation of the ultimate ramuli, mostly ovate. *Tetraspores* always lodged beneath the ends of the simple or compound ramuli.

From this genus, restricted by the above character, are now removed all the species (as *L. dasyphylla*, *L. tenuissima* and their allies) that have an articulated polysiphonous axis running through the frond. These will be found among *Rhodomelaceæ* under the genus *Chondria*. The remainder of the Grevillian genus *Laurencia* constitute a very natural group, dispersed through most parts of the temperate and tropical oceans. Very few occur on the shores of the Northern States, but on the Florida Keys there are many common species, some of them congregating in such masses that a large per centage of the drift seaweed is composed of their broken fronds.

The species are exceedingly difficult of determination. Many intermediate varieties often connect the most opposite looking specimens, and the new species here proposed are not offered without hesitation. Indeed, in this genus, as in many others, it is often impossible to tell whether we are dealing with species or sportive forms without a very careful examination of a number of specimens, or without some knowledge of the circumstances accompanying their development.

1. Laurencia *pinnatifida*, Lamour.; frond compressed, cartilaginous, dull purple, bi-tripinnatifid, all the divisions alternate, the ultimate ones obtuse, simple or lobed. *Harv. Phyc. Brit. t.* 55. *Kütz. Sp. Alg. p.* 856. *Harv. in Bot. Beech. Voy.*

p. 164 *and* 408. *Fucus pinnatifidus*, *E. Bot. t.* 1202. *Turn. Hist. t.* 20. *Laurencia spectabilis*, *Post. and Rupr. p.* 16 !

Hab. Monterey, California, *D. Douglas*, *Dr. Coulter*. (v. v.)

Root branching. *Frond*, in the Californian specimens, 8-12 inches long, one to two lines in diameter, compressed below, becoming flatter and wider upwards, decompound-pinnate. *Stem* dividing below into several branches, which are naked in the lower half and there entire or dentate at the margin, and closely pinnate or bipinnate above. In smaller individuals the branches are simply pinnate, the pinnæ from half an inch to an inch long, erecto-patent with rounded axils, alternate, at distances of the third of an inch apart, the upper ones somewhat opposite, crenate at the apex, the lower ones more and more pinnatifid. Fertile specimens are narrower, with subcylindrical laciniæ. *Conceptacles* ovate, sessile, two or more on the ultimate laciniæ. *Tetraspores* scattered toward the ends of the laciniæ. *Colour* a livid purple, becoming brownish in drying. *Substance* opaque, densely cellular. It imperfectly adheres to paper.

Dr. Coulter's numerous specimens are undistinguishable from some of my West of Ireland examples, and I see no character by which *L. spectabilis* P. and R. of which I have examined an authentic specimen, can be separated from the common *L. pinnatifida*, which is well known to be very variable in size and branching.

2. Laurencia *virgata*, J. Ag. ; frond terete, pinnately branched ; the branches spreading to all sides, opposite or verticillate, elongate, simple, racemoso-pinnated with short secondary branches ; ramuli opposite or whorled, erect, simple or corymboso-paniculate ; the tetrasporiferous ones clavato-cylindrical. *J. Ag. Sp. Alg.* 2 *p.* 752.

Hab. Monterey, California, *Dr. Coulter*. (v. v.)

Dr. Coulter's specimens are about six inches high. Several stems as thick as sparrow's quill rise from a mat of branching fibres. They are generally bare of branches at the base for an inch or two, and set above with closely crowded lateral branches which are not strictly distichous in insertion. In the less divided specimens, the branches are either naked and filiform, or somewhat pinnated ; in the more compound they are twice or thrice closely pinnated, the general outline being pyramidal. The lower part of the frond is slightly compressed, its lesser divisions more and more terete, and the ultimate pinnules cylindrical, remarkably truncate, and slightly constricted at the base. *Tetraspores* are imbedded toward the ends of the ramuli. *Colour* a very dark lurid purple, becoming still darker in drying. *Substance* cartilaginous, and structure dense.

I venture to refer the Californian specimens above described to the *L. virgata* J. Ag. a species founded on individuals collected at the Cape of Good Hope. I have compared them with Cape specimens, with which they agree in most points, and I

am unwilling on slight discrepancies to multiply species in this genus. The probability of specific identity is the greater because many other Cape Algæ occur on the Pacific coast of America.

3. Laurencia *obtusa*, Lamour.; frond cylindrical, pinkish red or yellow, twice or thrice pinnate, the pinnæ very patent; ramuli mostly opposite (occasionally alternate or irregular) patent, short, truncate. *Harv. Phyc. Brit. t.* 148. *Kütz. Sp. Alg. p.* 854. *Fucus obtusus*, *Turn. Hist. t.* 21. *E. Bot. t.* 1201.

Hab. Florida Keys, parasitical on corals and Algæ. Key West, *W. H. H.*, *Prof. Tuomey* (33, 40, 44, &c.) Apalachicola, *Capt. Pike* (69). Island of St. Catalina, California, *Lieut. Wood*, Brit. Navy. (v. v.)

Fronds in large subglobose tufts. *Stems* as thick as sparrow's quill, cylindrical, from one to six inches long, undivided or once or twice forked, decompound pinnate. *Branches* not strictly distichous, very patent, alternate or opposite, sometimes three from the same level, bi-tripinnate. *Pinnules* opposite, alternate, or in threes, cylindrical, truncate, very patent or subhorizontal, simple or with one or two pair of secondary pinnules. *Colour* in the stem and branches generally pale waxy yellow, with a reddish tinge, in the ramuli a beautiful pinky red. *Substance* cartilaginous, firm. In drying, it adheres pretty strongly to paper.

In the Florida specimens the ramuli are very frequently alternate, as sometimes occurs in those from Europe. Perhaps the following should be considered merely an exaggerated variety.

4. Laurencia *implicata*, J. Ag.; frond terete, slender, much branched, between pinnate and dichotomous, subfastigiate; the lesser branches very irregular, flexuous, patent; ramuli cylindrical, alternate or secund, simple or forked, truncate, slightly clavate. (Tab. XVIII. D.) *J. Ag. Sp. Alg.* 2, *p.* 745. *L. Forsteroides*, *Harv. in Herb. MSS.*

Hab. Key West, *W. H. H.* (36), *Prof. Tuomey* (23, 31, 50), *Dr. Blodgett* (54, 66.) (v. v.)

Tufts globose, dense. *Fronds* 4-5 inches high, as thick as sparrow's quill, excessively branched from the base, the branches spreading to all sides, decompound, irregularly forked, flexuous, alternately multifid above; their lesser divisions furnished with alternate or secund, cylindrical, scattered ramuli, two or three lines long, simple or forked. *Colour* a pinky red; orange or yellow in the branches, greenish on exposure and in decay. *Substance* cartilaginous. It adheres to paper in drying.

Only to be known from *L. obtusa* (of which it may be merely a variety,) by the irregular branching and much scattered, frequently secund ramuli. It seems in-

termediate in character between *L. obtusa* and the Australian *L. Forsteri*, Grev. (*Turn. Hist. t.* 77.)

Plate XVIII. D. *Fig.* 1. Laurencia *implicata* ; a branch, the *natural* size. *Fig.* 2, a portion, somewhat *magnified.*

5. Laurencia *cervicornis* ; frond terete, robust, irregularly branched, subdichotomous ; the secondary branches curved upwards, spreading to all sides, having a few secund, cylindrical, obtuse ramuli ; axils rounded ; conceptacles broadly ovate with a projecting orifice, sessile near the tips of the ramuli. (Tab. XVIII. C.)

Hab. Key West, *W. H. H.* (31), *Dr. Blodgett.*

Tufts globose, somewhat fastigiate. *Fronds* as thick as crow's quill, 4-5 inches long, much branched from the base, bushy, very irregular in ramification, the branches spreading widely and directed to every side, curved upwards, of somewhat equal height, making a loosely corymbose head, naked, or having along their upper side, at distances of a quarter to half an inch, several cylindrical, secund ramuli. *Ramuli* erecto-patent, obtuse, quite simple or ramulose at the tip, from a quarter to half an inch long or more. *Conceptacles* at or near the ends of the branches, partly imbedded, very broad in proportion to their length, with a projecting, acute orifice. *Colour* a dark brownish red. *Substance* rigid, scarcely adhering to paper.

Seemingly allied to *L. Forsteri*, but more robust than the strongest grown specimens of that species, and less dichotomous.

Plate XVIII. C. *Fig.* 1, a branch of Laurencia *cervicornis*, the *natural* size. *Fig.* 2, apex of branch, with conceptacle ; *fig.* 3, spore ; both *magnified.*

6. Laurencia *gemmifera* ; fronds robust, cartilaginous, fragile, terete, flexuous, irregularly much branched ; branches patent, alternate, unequal, irregularly pinnate or bipinnate, set throughout with minute, bud-like, horizontal, scattered, spirally disposed, truncate ramuli. (Tab. XVIII. B.) *β.* decompound-pinnate, the pinnæ tolerably regular and very patent.

Hab. Florida Keys. Key West, *W. H. H.* (34), *Dr. Blodgett* (36) var. *β.* Key West, *W. H. H.* (30), *Prof. Tuomey* (30, 38, 53), *Dr. Blodgett* (49). (v. v.)

Fronds growing in large, loose bundles, 6—8 inches long, as thick as crow-quill, shrinking in drying, much and very irregularly branched, the branches spreading toward every side, and subspirally inserted, alternately or irregularly scattered, very flexuous, having secondary branches at distances of a quarter to half an inch. These branches are of very unequal length, long and short intermixed, and are patent, with rounded angles, and much curved or arched, and sprinkled throughout with exceedingly minute, bud-like ramuli. *Ramuli* spirally disposed round the

branches, horizontal, truncate, very short, simple or tubercled, sometimes slightly longer and pinnulate. *Colour* of the branches pale red or waxy yellow. *Substance* cartilaginous and brittle. In drying, the plant shrinks much, and very imperfectly adheres to paper.

What I call var. *β.* differs from the normal form in being more regularly pinnate and bipinnate, with closer branches. It is also of a brighter colour, and its ramuli are sometimes expanded at the apex into perforate or umbilicate cups, and rather more compound than in var. *a.*

This plant grows commonly at Key West in shallow water between tide-marks on the north side of the town. I cannot refer it to any described species. It is much more robust than *L. obtusa*. Its very flexuous irregular ramification, bud-like ramuli and brittle substance distinguish it from other Key West species.

7. Laurencia *papillosa*, Grev.; fronds terete, cartilaginous, sub-pinnate or irregularly decompound; branches filiform, simple, densely covered with short, quadrifarious, horizontal, simple or lobed papilliform ramuli; conceptacles ovate, sessile. *J. Ag. Sp. Alg.* 2, *p.* 756. *Chondria papillosa*, *Ag. Sp. Alg. vol.* 1, *p.* 344. *Fucus thyrsoides*, *Turn. Hist. t.* 19.

Hab. Florida Keys. Key West, *Mr. Binney*, *W. H. H.* (33), *Prof. Tuomey*, (54, 56, 57). (v. v.)

Fronds tufted, 4—6 inches long, as thick as a sparrow's or as a crow's quill, terete, undivided or vaguely forked, naked below, branching above. *Branches* directed every way, either distant or densely crowded, simple, one to three inches long, virgate, tubercled with close-set quadrifarious, wart-like ramuli, which in old specimens are multifid and much distorted. *Colour* a dull purple, changing to green. *Substance* firmly cartilaginous. In drying, it scarcely adheres to paper.

Somewhat variable in ramification and in size, but readily known by the densely crowded, wart-like ramuli with which the branches are completely covered. In old specimens these ramuli are much compounded, and resemble miniature heads of cauliflower.

8. Laurencia *scoparia*, J. Ag.; "greenish, somewhat horny; frond terete, filiform, distichously decompound; branches irregularly set, erecto-patent, some opposite, some secund, virgate; fertile ramuli, very short, tufted at the apices of the branches, subclavate, bearing tetraspores under the truncate apices." *J. Ag. Sp. Alg.* 2. *p.* 746.

Hab. La Guayra, Herb. *Binder.*

"Two to four inches high, densely tufted, rigid, with the substance and nearly the habit of *Ahnfeltia plicata*. *Frond* as thick as sparrow's quill, very much branched."

9. Laurencia *tuberculosa*, J. Ag. ; "rosy purple, frond compressed, distichously decompound-pinnate ; pinnæ on a straight, excurrent rachis, alternate, patent ; the medial pinnules similar, the lower short, transformed into roundish, tuberculated warts, bearing tetraspores lodged in the tubercles." *J. Ag. Sp. Alg.* 2, *p.* 760.

Hab. Vera Cruz, *Liebman.*

"*Frond* 4—6 inches long, as thick as a pigeon's quill, subterete or slightly compressed, alternately and distichously bi-tri-pinnate ; rachides scarcely conspicuously flexuous, obtuse, prolonged, naked beyond the pinnæ. Primary pinnæ 3—4 inches long, secondary an inch and half."

II. CHAMPIA. *Desv. Harv. ref.*

Frond terete or compressed, branched, tubular, constricted at intervals, and furnished internally at the constrictions with transverse membranous diaphragms which divide the tube into chambers; diaphragms connected by a few longitudinal, confervoid filaments ; walls of the frond composed of polygonal cellules, in one or many rows. *Conceptacles* ovate, with a terminal pore. *Placentæ* one or many, basal, much branched, confervoid, connected with the walls by confervoid threads, and bearing on the ends of the branches densely crowded ovoid or obconic *spores. Tetraspores* tripartite, scattered through the superficial cells of the branches and ramuli.

The genus now called *Champia* was founded in 1804 by Thunberg under the name *Mertensia*, a name previously given by Dr. Roth (1797) to a well-known Boragineous plant of North America. Thunberg's original species, *Ch. lumbricalis*, a native of the Cape of Good Hope, remained for about thirty years the sole member of the genus ; but recently two others, *C. compressa* from the Cape, and *C. Tasmanica* from Van Dieman's Land, have been added. These three constitute the genus *Champia* as generally understood by algologists, and as it appears restricted by Prof. J. Agardh in his *Sp. Alg. vol.* 2, *p.* 368. I venture now to add to them such species of *Lomentaria* of authors (*Chylocladia* of Greville and other British writers) as have ovate conceptacles furnished with a terminal pore ; because I find, on carefully examining their sporaceous nucleus, that it is formed exactly on the type of that of *Champia lumbricalis*, and not at all as in *Lomentaria kaliformis*, the type of the true *Lomentariæ*. In our *Ch. parvula* and *Ch. salicornoides* the placenta is less paniculate than in *Ch. lumbricalis*, but nevertheless is much branched, as

may readily be seen if a conceptacle from which the spores have been shed be carefully dissected. The placenta in such conceptacles will be found not unlike a bird-cage or the open net-work of a clathroid fungus, nearly filling the cavity, and connected with the surrounding walls by cross threads. This is precisely the structure in *Ch. lumbricalis*, *compressa* and *Tasmanica*, as well as in *Chylocladia affinis*, Harv. (*Ner. Austr. t.* 29), which therefore I now remove to *Champia*. *Chylocladia Novæ Zealandiæ*, Hook. and Harv., whose conceptacles are unknown, is probably also a *Champia*. The genus so constituted forms a natural group, all the species having a constricted frond divided into loculi by transverse septa. I differ with my friend Prof. J. Agardh in regard to its nearest affinities; he referring his *Champia* to the neighbourhood of his recently amended genus *Chylocladia* (founded on *Chrysymenia clavellosa* of his former writings), whilst I am of opinion that it is much more nearly connected with *Lomentaria*.

1. Champia *parvula*, Harv.; tufts globose, dense; frond irregularly branched, ramuli scattered; branches and ramuli constricted at intervals of once or twice their diameter; conceptacles scattered. *Chylocladia parvula*, *Grev. Harv. Phyc. Brit. t.* 210. *Lomentaria parvula*, *Zanard. J. Ag. Sp. Alg.* 2, *p.* 729. *Kütz. Sp. Alg. p.* 864.

Hab. On the smaller algæ, &c. between tide marks. Nantucket, *Miss Mitchell.* Seaconnot, Newport and Narragansett Pier, *Prof. Bailey* and *Mr. Olney.* Peconic Bay, *Prof. Bailey* and *W. H. H.* Hellgate, New York, *Mr. Hooper* and *Mr. Congdon.* Key West, *W. H. H.*, *Dr. Blodgett* (71) and *Prof. Tuomey* (38). (v. v.)

Tufts globose, often intricate, two to four inches in diameter. *Fronds* as thick as sparrow's quill, very irregularly branched; the branches sometimes somewhat pinnately compounded, all or most of the divisions alternate; sometimes and more frequently several times irregularly forked below, and inordinately branched above. Branches and ramuli very patent, linear, ending in a blunt point. The main divisions are either regularly constricted and septate throughout, at intervals of once and half their diameter, or are sub-cylindrical and obsoletely constricted in the lower part; all the lesser branches and ramuli are obviously articulato-septate. *Conceptacles* scattered over the branches, very prominent, conical or ovate, thick-walled. *Colour* brownish red, purplish, or waxy yellow. *Substance* softly cartilaginous. It closely adheres to paper in drying.

A variable plant. Most of our specimens nearly agree with common European varieties. One, received from Mr. Congdon, is more pinnate than the others, and rather more robust. Another variety found by Mr. Hooper at Greenport is much more slender than usual, scarcely thicker than hog's bristle, with the constrictions obsolete, or not visible without close examination. I have British specimens nearly similar.

2. Champia *salicornoides*; frond cylindrical and inarticulate at the base, nodoso-constricted upwards, whorled with one or more sets of short moniliform, obtuse

branches ; internodes about as long as broad ; conceptacles conical, scattered. (Tab. XIX. B.)

Hab. At Key West, *W. H. H.* (27), *Dr. Blodgett* (72). (v. v.)

Root discoid. *Fronds* two or three inches high, about a line in diameter, tufted. *Stems* at first filiform, cylindrical and solid for half an inch or more, then distended and either continued as a single articulato-constricted simple stem, or dividing into a tuft of such stems. These *upper* stems are regularly constricted at short intervals, and are thickest in the middle and gradually taper to the base and apex. *Branches* opposite or whorled, similarly constricted, the lowest longest, and in fully developed specimens furnished with a second or third series of shorter branches and ramuli. All the lesser divisions are nodose, the internodes about as long as broad. The conceptacles are conical, scattered over the ramuli, their walls very thick and the sporiferous nucleus very densely tufted. *Tetraspores* very minute, dispersed through the ramuli. *Substance* softly cartilaginous. In drying it closely adheres to paper.

This has a habit very similar to that of *Lomentaria Mediterranea*, J. Ag. with which I had at first confounded it, but it is readily distinguished by its very different conceptacles, the nucleus of which is not correctly given in our plate, *figs.* 5, 6, which were taken from a hastily examined and imperfect specimen. The structure of the sporiferous nucleus is exactly the same as in *Ch. parvula*, from which this species differs very much in ramification. I gathered very few specimens at Key West.

Plate XIX. B. *Fig.* 1. Champia *salicornoides*, the *natural* size. *Fig.* 2, section of a branch to show the hollow chambers and diaphragms : *fig.* 3, branch with conceptacles ; *fig.* 4, a conceptacle ; *fig.* 5, section of the same (the contained nucleus incorrectly drawn) ; *fig.* 6, nucleus (incorrect) ; *fig.* 7, spores ; all more or less *magnified*.

III. LOMENTARIA. *Endl.* excl. sp.

(Gastridium, *Lynb.* Chylocladia, *Grev. ; Harv. Phyc. Brit. excl. sp.*)

Frond (at least the branches) tubular, constricted at regular intervals and divided by internal membranous diaphragms into chambers filled with a watery juice and traversed by a few longitudinal confervoid filaments ; walls of the frond composed of polygonal cellules in one or many rows. *Conceptacles* spherical, without orifice : *sporiferous nucleus* globose, very dense, consisting of many obconic, subsessile spores radiating from a minute basal placenta. *Tetraspores* tripartite, scattered through the superficial cells of the branches and ramuli.

The type of this genus, restricted by the above diagnosis, is *Fucus kaliformis*, Good and Woodw. (*Chylocladia kaliformis*, Grev. and of other British writers,) to which are added the other species of the Grevillean genus *Chylocladia*, which have similarly organised conceptacles. In the structure of the frond there is a very close affinity with *Champia*, but the difference in the sporiferous nuclei in the two genera is too important to admit of their union. A still greater difference in the fructification separates the reformed genus *Chylocladia*, as now understood by Prof. J. Agardh.

I adopt the name *Lomentaria* for the present genus in deference to the authority of Endlicher, Montagne, Kützing, and J. Agardh, and in order to avoid confusion in nomenclature; but it unfortunately happens that *L. articulata*, Lyngb. the plant originally called *Lomentaria* by Lyngbye, and to which he restricted his genus, must be removed from the modern genus as at present adopted by botanists.. Dr. Greville, long ago (Alg. Brit. p. 114) remarked that his genus *Gastridium*, afterwards called *Chylocladia*, included *two* generic types, indicated by differences in fructification, a character which, at the time he wrote, was not considered of sufficient importance apart from others, to justify the dismemberment of the genus. One of these types, comprising *Ch. kaliformis*, *ovalis*, and others with similar fructification, constitutes the modern *Lomentaria*; the other, comprising *Ch. clavellosa*, *articulata*, and others, the reformed genus *Chylocladia*, J. Ag. Now should the spirit of genus-splitting proceed further at a future time, and *Ch. articulata*, on account of its articulated frond, be separated from the species of *Chylocladia* with tubular fronds, it must either receive a *new* name, or if its old one, *stolen* for the present genus, be restored to it, we shall have to find a name to supply the deficiency, and perhaps *Gastroclonium* of Kützing may then be applied to the group typified by *Ch. kaliformis*.

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1. Lomentaria *ovalis*, Endl.; frond cylindrical, solid, irregularly dichotomous, naked below, above beset with simple, elliptical, or elongated and nodoso-articulate tubular ramuli. *Harv. Phyc. Brit. t.* 118. *Gastroclonium ovale*, *Kütz. Sp. Alg. p.* 865. Var. β. *Coulteri*; frond robust, livid purple, with very obtuse, obovate, simple ramuli. (Tab. XIX. A.) Var. γ. *subarticulata*, Turn.; ramuli long, linear, contracted and jointed, *Turn. Hist. t.* 81, *n.*

Hab. On the Pacific Coast. β. at Monterey, California, *Dr. Coulter*. γ. Nootka Sound, *Mr. Menzies*, 1787. (v. s. in Herb. T. C. D.)

In Dr. Coulter's specimens the stems are tufted, six to eight inches high or more, cylindrical, solid, thicker than crow-quill, dichotomous, flexuous with rounded axils. *Branches* erect, somewhat corymbose, sparingly divided, usually naked for the greater part of their length, densely beset near the summit with elliptic-oblong or clavate, simple, hollow, very obtuse ramuli, and here and there furnished with a few short, lateral branchlets ending in a tuft of similar bag-like ramuli. The walls of the ramuli are thick, composed of several rows of angular, coloured cellules.

Conceptacles not seen. *Tetraspores* of large size are scattered through the walls of the ramuli. *Colour*, judging from dried specimens, a dark lurid purple, turning greenish in decay. *Substance* tough, rigid when dry. In drying, it does not adhere to paper.

This is of firmer and more rigid texture and of darker colour than the ordinary European *L. ovalis*, and at one time I considered it specifically distinct. Recently I have seen and examined Mr. Menzies' Nootka specimen, which is much more like some of the dwarf English states of the species, and I am now of opinion that it is better to retain my *L. Coulteri* as a variety only.

There is much agreement in external habit between *L. ovalis* and *Chrysymenia uvaria*, but the fructification is widely different.

Plate XIX. A. *Fig.* 1, Lomentaria *ovalis var. Coulteri*, the *natural* size. *Fig.* 2, a ramulus with tetraspores; *fig.* 3, small portion of a section of the wall of the same; *fig.* 4, cross section of one of the solid branches.

2. Lomentaria? *saccata*, J. Ag.; "Stem solid, short, densely branched, supporting obovate, vesicular ramuli attenuated at base into a slender petiole; tetraspores scattered through the ramuli; conceptacles numerous, approximate, scarcely hemispherical, inflated, sub-immersed." *J. Ag. Sp. Alg.* 2, *p.* 738. *Dumontia saccata*, *Grev. MS.*

Hab. California, Herb. *Greville.*

"*Stems* scarcely an inch high, as thick as a pigeon's quill, terete, solid, irregularly much-branched. *Ramuli* sub-heterogeneous, emerging from the branches, borne on setaceous petioli, saccate, resembling obovate, ellipsoid, inflato-tubulous bags, collapsed when dry, three to ten lines in length, and two to six in diameter. *Conceptacles* densely aggregated. *Colour* a blackish purple. *Substance* of the stem carnoso-cartilaginous; of the ramuli membranaceous."

This species is wholly unknown to me.

Order III. CORALLINACEÆ.

Corallineæ, Lamour. Cor. Class. p. 244. *Dne. Class. p.* 63. *Endl. 3d. Suppl. p.* 48. *Harv. Ner. Austr. p.* 92. *Lindl. Veg. King. p.* 25. *Corallineæ and Spongiteæ, Kütz. Phyc. Gen. pp.* 387, 385. *Kütz. Sp. Alg. pp.* 695, 699. *Corallinidæ and Nulliporidæ, Johnst. Brit. Lith. p.* 205.

Diagnosis. Rigid, stony, articulated or crustaceous, mostly calcareous sea-weeds, purple when recent, fading, on exposure, to milk-white, composed of closely packed, elongated cells or filaments, in which carbonate of lime is deposited in an organized form. *Spore-threads* short, tufted in the base of encysted conceptacles, furnished with a terminal pore, simple, each thread at length separating into four *spores*.

Natural Character. *Root*, when manifested, an expanded, crustaceous disc, often spreading widely over the rock or shell to which it is attached. *Frond* calcareous, effervescing strongly when thrown into acid, the cells of which it is composed secreting carbonate of lime in an organized form within their walls, and calcareous matter being also deposited on the surface of the cells and between their interstices. The whole compound frond then appears to the eye as if coated with enamel, and when broken, seems equally stony within. On maceration in acid, the rigid substance becomes soft and pliable, and sub-transparent, and the cellular tissue is obtained free from lime. The cells composing the axis or medullary part of the stem are long, slender and vertical, either closely packed together and overlapping at the ends, or disposed in filamentous series. Those which immediately surround this central layer are shorter and curved outwards, and the cells of the periphery are very minute. A longitudinal section of the stem has frequently a transversely banded appearance, from the cells of which it is composed being nearly of equal length and so placed that their ends stand on a level.

In outward habit there is considerable variety among these plants. The lowest forms of the order are simply incrustations, spreading like the least organized of the crustaceous lichens, over the surface on which they grow, and like them usually extending from a central point in successive concentric circles of growth. Some are mere films, as thin as tissue paper ; others are thick and stone-like, the crust rising into prominences or sinking in depressions. The surface of the thicker crusts is very frequently papillated with conical wart-like prominences, scattered or densely aggregated. In the more advanced kinds these lengthen into cylindrical processes, and become branched, the branches often so densely crowded that little more than their ends are visible, in which case the

mass resembles a stony head of cauliflower, or some of the incrustations of similar aspect so often seen in calcareous spar caves. Others are more shrub-like or arborescent, and in others the branches become compressed, or flattened into leafy lobes. In the genus *Mastophora*, the most leaf-like plants of the Order, there is less carbonate of lime deposited than in most others, and the fronds are proportionably flexible ; they are fan-shaped, with fastigiate leafy laciniæ, and have a habit very similar to that of some species of *Zonaria*. All the above varieties of form are found in the sub-order *Nulliporeæ* (*Spongiteæ*, Kütz). The true Corallines or *Corallineæ* are filiform, somewhat compressed, pinnated or dichotomous, the branches composed of strings of calcareous articulations or internodes, truncated at the upper extremity and rounded at the lower, each articulation connected with that above and below it by a flexible node or joint formed of cellular tissue, in which no calcareous matter is deposited. In the majority, the calcareous internodes are separated by minute flexible nodes, often hidden under the projecting edges of the internode, and only to be seen on close examination. But in some species of *Amphiroa* the flexible node is elongate, and even occasionally longer than the calcareous internode, the branches of such species looking like a number of beads or *bugles*, distantly placed on a connecting thread. In some of these latter the surface of the node is occasionally armed with minute calcareous plates or tubercles. The form of the internode varies extremely ; often in the same species ; or even in different parts of the same individual, in which it is common to find the articulations of the stem, the branches and the ultimate ramuli having distinct forms. In many the internodes are cylindrical ; in others oval or compressed ; in others flat and with an irregular outline ; but the most common forms are cordate and cuneiform, the upper angles or shoulders of the internode often extending into ears or horns.

The fructification is not perfectly ascertained, and the position and affinities of the order are therefore uncertain. It is not without hesitation that I now give the name of *four-jointed spore-threads* to the little bodies found tufted in the base of the conceptacles, and which in another place (Phyc Brit. t. 201, 222, 252) I have figured and described as *zonate tetraspores*. If we are to judge of their nature by their *aspect*, we shall certainly, with Decaisne and other writers, regard them as *tetraspores* ; but if by the position they occupy within conceptacles formed on the type of those of *Polysiphonia*, we shall pronounce them *spore-threads*. If they were not four-parted, they would very closely resemble the *spore-threads* of a *Polysiphonia ;* and they occupy a place exactly similar, being transformations of the same parts of the frond, and similarly protected within conceptacles, whose form and origin are identical with those of the conceptacles in *Polysiphonia*. So that *morphologically* speaking, we are compelled to regard them as spore-threads. If this be their real nature, it may be worth enquiry whether the supposed *tetraspores* of *Phacelocarpus* and *Apophlæa* are not to be regarded as strings of spores, being found lodged within hollow conceptacles, to the walls of which they are attached. I am aware that other conceptacles have been described in *Phacelocarpus*, but after an examination of many specimens I have failed to detect perfect spores within them, and consequently consider them as merely abortive efforts at fructification ; an

opinion rendered more probable by their *position*, which is the same as that of the fertile branchlets.

The conceptacles in the Corallineæ are either formed out of the terminal articulations of the lesser branches, as in *Corallina* and *Jania* ; or on some part of the surface of the middle and lower articulations, as in *Amphiroa*. But frequently spurious conceptacles, equally furnished with spore-threads as the normal ones, sprout out irregularly from any part of the stem or branch. This I have repeatedly observed in *Corallina squamata* and *C. officinalis*, whose whole surface is sometimes densely warted with such irregular fructification.

The Corallinaceæ, under some form or other, are dispersed through most parts of the ocean, and at depths varying from the highest level of ordinary tides to many fathoms below low-water mark. The crustaceous kinds in particular abound on the stones and in shallow places, where, however, they seldom exhibit more than an expanded crust. Within the tidal limits, from the level of half-tide to low-water mark, they flourish, fruiting abundantly. Beyond the tidal limit, in water of 5, 10, 15, or even 50 fathoms in depth, they are still numerous, and frequently constitute vast banks, made up of unattached fronds heaped together without order, of which those alone on the surface of the bank are in a vegetating state. In such places, though the frond is very luxuriant, fructification is seldom formed. It is extremely probable that many of these deep-water forms, now regarded as specifically different from those found within tide marks, are merely barren varieties of the tidal species, altered by a different locality. The true corallines are very rare in the colder sea, in which alone *C. officinalis* attains a very high latitude. They are more abundant towards the tropics, and seem to be particularly numerous and beautiful on the shores of the Australian continent. As yet we can claim few within the limits of the North American Flora, but probably when the Pacific coast shall have been explored many new species will reward the collector. On the whole, the order is greatly more numerous in the Pacific than in the Atlantic Ocean.

Until recently the *Corallinaceæ*, and other calcareous Algæ, such as *Halimeda*, were confounded with the polypiferous Zoophytes, with which division of the animal kingdom they had been united by Ellis, who, nevertheless, figures the *spore-threads* of *C. officinalis* with his usual care.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

Sub-order 1. Corallineæ. *Frond* filiform, pinnate or dichotomous, jointed.

I Corallina. *Conceptacles* terminal, urceolate, simple. *Frond* pinnated.

II. Jania. *Conceptacles* terminal or axillary, turbinate, tipped with two horn-like ramuli. (*Frond* in our species dichotomous.)

III. Amphiroa. *Conceptacles* conical, scattered on the surface of the middle and lower articulations.

Sub-order 2. Nulliporeæ. *Frond* crustaceous, foliaceous or shrubby, not jointed.

IV. Melobesia.

I. CORALLINA, *L.*

Frond filiform or compressed, calcareous, articulated, mostly pinnate. *Nodes* very short, striæform. *Conceptacles* ovate or urceolate, formed from the terminal articulation of the branches and ramuli, furnished with an apical pore, and containing in the base of the cavity a tuft of erect, pyriform or club-shaped, at length four-parted spore-threads.

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1. Corallina *officinalis*, Lin. ; decompound pinnate ; the lower articulations cylindrical, twice as long as broad ; the upper slightly obconical, round-edged (not ancipital), their upper angles blunt ; the ultimate ramuli cylindrical, obtuse. *Harv. Phyc. Brit. t.* 222. *Kütz. Sp. Alg. p.* 705.

Hab. On stones and shells. Halifax, *W. H. H.* (v. v.)

Fronds two to four inches high, twice as thick as hog's bristle, distichous, decompound pinnate. *Branches* pinnate or bi-pinnate, especially at the top, sometimes naked below, often fastigiate or corymbose, erecto-patent ; pinnules mostly simple, attenuate. *Articulations* of the stem as long or twice as long as broad, sub-cylindrical ; of the branches more or less cuneiform, with rounded shoulders ; of the ramuli linear, cylindrical, or compressed, the terminal one either obtuse or pointed. *Conceptacles* formed either from the terminal articulation of a pinna, or from the surface of any of the articulations of the stem or branches, ovate. *Colour* dark lurid-purple when growing, becoming chalk-white when bleached.

A very variable plant, according to the depth of water at which it vegetates. It is probably common on the American shores, though I have not received it from my correspondents.

II. JANIA, *Lamour.*

Frond filiform or compressed, calcareous, articulated, dichotomous, or (in some Australian species) decompound pinnate. *Nodes* very short, striæform. *Concep-*

tacles urn-shaped, formed from the axillary articulation of the uppermost branches (mostly two-horned), furnished with an apical pore, and containing in the base of the cavity a tuft of erect, pyriform or club-shaped, at length four-parted spore-threads.

This genus scarcely differs from *Corallina*. The species are generally smaller and more slender, and those of North America are dichotomous, at least in the main divisions, and therefore easily known from the pinnated Corallines. Many of the Australian species of *Jania*, comprising the section *Haliptilon*, are however decompound pinnate.

1. Jania *rubens*, Lamour. ; frond dichotomous, fastigiate, setaceous ; articulations of the principal branches and ramuli cylindrical, about four times as long as broad. *Harv. Phyc. Brit. t.* 252. *Kütz. Sp. Alg. p.* 709.

Hab. At Key West, *W. H. H.* (v. v.)

Fronds half an inch to an inch high, densely tufted, many times forked, as thick as hog's bristles ; branches erect or spreading, gradually tapering to the extremities. *Articulations* cylindrical in all parts of the frond ; those near the base very short, the upper ones gradually longer ; those in the middle region from four to five times as long as broad. *Colour* a pale red.

2. Jania *Cubensis*, Mont.; frond dichotomous, fastigiate, setaceous, the branches naked or pinnated with short, simple or forked, opposite ramuli ; articulations of the lower branches subcylindrical, of the upper cuneate with rounded shoulders, of the ramuli cylindrical, three or four times as long as broad. *Kütz. Sp. Alg. p.* 709.

Hab. Parasitical on *Digenia simplex*, and other Algæ, at Key West, *W. H. H.*, *Prof. Tuomey* (71).

Tufts dense, an inch in height, fastigiate, often spreading widely. *Fronds* as thick as hog's bristle, dichotomously divided, the branches patent or sometimes recurved, either destitute of ramuli (when the plant is hardly to be known from *J. rubens*) or pinnellated throughout with short ramuli, one or two lines in length. *Ramuli* distichous, or three together, simple and spinelike or forked, sometimes trifurcate and now and then lengthened and pinnellated. *Articulations* in the lower part subcylindrical, the upper ones more cuneate. *Colour* a dull red.

My specimens seem to agree very closely with a small authentic specimen kindly communicated to me by Dr. Montagne.

3. Jania *capillacea* ; minute, dichotomous, capillary, with wide axils ; branches

recurved, squarrose; articulations cylindrical, four to six times as long as broad.

Hab. Bahia Honda, *Prof. Tuomey.* (70). (v. s. in Herb. T. C. D.)

I cannot satisfactorily refer the specimen received from Prof. Tuomey to any described species. It most resembles *J. rubens* in written character, but is much smaller and more slender, having more the aspect of *J. antennina*, Kütz. from which its much longer articulations separate it.

III. AMPHIROA. *Lamour.*

Frond terete, compressed, or flat, calcareous, articulated, dichotomous or pinnated. *Nodes* cartilaginous, more or less evident, sometimes elongate, naked or covered with tubercles. *Conceptacles* conical, wartlike, sessile on the disc of one of the articulations, furnished with an apical pore, and containing in the base of the cavity, a tuft of erect pyriform, at length four-parted spore-threads.

An extensive genus, chiefly found in the Southern and Pacific Oceans, where many of the larger and more beautiful species abound. A few occur in the Mediterranean, and in the Tropical Atlantic. There is much variety of habit among them, and Decaisne has divided the genus into four subgenera, two only of which are represented in the North American Flora. The species of the first subgenus have a habit quite peculiar, and are much more brittle than any other of the jointed Corallines. Those of the second group have the habit of *Corallina*, from which they are only to be known by the fructification.

Sub-genus 1. *Euamphiroa. Articulations* linear, elongate, terete or subcompressed. *Conceptacles* scattered, numerous.

1. Amphiroa *fragilissima*, Lamour.; frond dichotomous, robust, attenuated upwards, very fragile; the axils wide, and branches spreading; articulations cylindrical, smooth, four or five times as long as broad. *Lamour. Cor. p.* 298. *Kütz. Sp. Alg. p.* 700. *Ellis and Soland. Cor. t.* 21, *fig. d. (not characteristic).*

Hab. Florida Keys. Key West, *W. H. H.* (v. v.)

Fronds 2—3 inches high, very fragile, as thick as sparrow's quill below, gradually

attenuated upwards, many times dichotomous, the articulations below the fork bifid at the apex, each lobe running out into the commencement of the arms of the forks. *Axils* wide. *Branches* divaricate. *Articulations* cylindrical, smooth, not swollen at the extremities, the nodes very short, indicated by a line only. *Colour* livid purple, fading to dirty white.

An exceedingly fragile species, of which it is almost impossible to preserve more than broken fragments.

2. Amphiroa *debilis*, Kütz.; frond setaceous, dichotomous, fastigiate, very fragile; branches divaricating; articulations many times longer than broad, cylindrical, thickened at each extremity; conceptacles numerous, subsecund. *Kütz. Sp. Alg. p.* 700.

Hab. Florida Keys. Key West, *W. H. H.* (v. v.)

Fronds 1—2 inches high, as thick as hog's bristle, repeatedly and pretty regularly dichotomous, occasionally trichotomous, the articulations below the dichotomy similar to the rest (not bifid or two branched). *Branches* spreading to all sides. *Articulations* generally but one between each furcation, cylindrical, those of the lower and middle regions of the frond incrassated at each end, the upper ones not so. *Interstices* or nodes simple, scarcely uncovered. *Conceptacles* numerous on the lower articulations, generally several ranged along one side of the internode.

A much smaller plant than the preceding, with differently shaped articulations. I have not seen any authentic specimen of Kützing's plant, which came from Cuba, but my specimens collected within eighty miles of Havana seem sufficiently to agree with his description.

3. Amphiroa *cretacea*, Endl.; "dichotomous, diffuse, thick, chalky or ash-coloured; articulations cylindrical, approximate, 1–2 lines long, once and a-half or twice as long as their diameter; branches distant, flexuous and recurved, cylindrical or conical at the apex." *Kütz. Sp. Alg. p.* 701. *Post. and Rupr. Illustr. p.* 20. *t*, 40, *Fig.* 104.

Hab. Unalaschka, *Postels and Ruprecht.*

Sub-genus 2. Arthrocardia. *Articulations* strongly compressed, frequently winged at the sides, cuneate or obcordate. *Conceptacles* conical, scattered.

4. Amphiroa (Arthrocardia) *Californica*, Dne. (?); subdichotomous or irregularly branched; articulations strongly compressed, with a sub-evident midrib, the lowermost cuneate, the upper broadly obcordate with blunt upper angles; conceptacles two to four on each fertile articulation. *Dne. Coralt. p.* 112 *?* *Kütz. Sp. Alg.* 704. *A. Hookeri, Harv. in Hook. Herb.*

Hab. Monterey, *Decaisne.* St. Francisco, *Barclay.* (v. s. in Herb. T. C. D.)

The St. Francisco specimens are three or four inches long, twice or thrice irregularly forked, the ultimate divisions dichotomous, the lower ones irregularly pinnated with numerous, lateral, simple branches. All the articulations are strongly compressed, the sides depressed, the central part raised and rib-like ; the lower ones of the larger branches as well as of the lower divisions are cuneate, the upper gradually broader and more cordate, with much produced but rounded upper angles ; the terminal articulations narrow. *Conceptacles* large, on my specimens generally in pairs on each articulation, but sometimes four or five on the lower ones.

I have not seen any authentic specimen of the plant of Decaisne, who describes it thus ; " dichotomous ; articulations compressed, and frequently cuneate, and generally furnished with four conceptacles on each face :" characters which do not strictly apply to my specimens, which nevertheless, I hesitate to describe as new.

5. Amphiroa (Arthrocardia) *tuberculosa*, Endl.; " dichotomous ; dirty white or rosy violet ; lowest articulations subterete, once and half as long as broad, upper dilated, more or less deeply obcordate, uppermost sub-approximate, irregularly cuneate-rhombic, sometimes linear, tuberculated at the back and margin ; some of the tubercles perforated ; branches scattered, subsimple, clavate or emarginate at the apex." *Kütz. Sp. Alg. p.* 704. *Corallina tuberculosa, Post. and Rupr. Ill. p.* 20, *t.* 40, *fig.* 100.

Hab. Island of Sitcha, *Postels and Ruprecht.*

I have seen no specimen of this or of the preceding species.

MELOBESIA. *Lamour.*

Frond attached by its lower surface or free ; either flattened orbicular, sinuated or irregularly lobed ; or cylindrical and branched ; never articulated, coated with a calcareous deposit. *Conceptacles* conical, scattered over the surface of the fronds or partly immersed, furnished with an apical pore, and containing in the base of the cavity a tuft of erect, oblong, four-parted spore-threads.

The North American species of this genus have not yet been carefully examined or collected. Probably several occur along the coast, and will be found either encrusting tidal rocks or stones, or lying at the bottom of harbours in from five to

twenty fathom water. Authors enumerate many forms which are probably but variable shapes assumed by the same species at different times. Thus *M. membranacea, farinosa, verrucata* and *pustulosa* of Lamouroux, appear scarcely to differ from each other except in age and luxuriance. By Dr. Johnston the whole are regarded as abnormal states of *Corallina officinalis.*

Order IV. SPHÆROCOCCOIDEÆ.

J. Ag. Sp. Gen. and Ord. Floridearum, p. ix. Part of Delesserieæ and Sphærococcoideæ, J. Ag. Alg. Medit. p. 116 *and* 148. *and of Endl.* 3*d. Suppl. Harv. Man. Ed.* 2, *&c.*

Diagnosis. Rosy, purplish, or blood-red sea-weeds, with an inarticulate, cartilaginous or membranaceous, leaf-like or filiform frond, composed either of polygonal or of cylindrical cells. *Conceptacles* with or without a terminal pore. *Spores* roundish or elliptical, formed in moniliform filaments rising from the basal placenta, all the cells of the spore-threads gradually changing into spores. *Tetraspores* variously disposed.

Natural Character. *Root* almost always discoid, rarely branching. *Frond* much diversified in habit, structure, and colour. Most of the North American genera are more or less perfectly leaf-like ; the leaf, in the least organised, being an expansion of irregular form, cleft either vertically or laterally, without symmetry, and destitute of central rib or of veins. In others the lower part of the frond is thickened in the centre into a broad, sub-defined midrib, which becomes less evident toward the upper portion of the membrane, and gradually disappears where the laciniæ become expanded. In others numerous irregular veins, which are confluent toward the base of the frond, spread out one from another like the rays of a fan and traverse a greater or less portion of the membrane, generally becoming obsolete in its upper divisions ; sometimes standing apart and sometimes anastomozing. In others—and these are the most completely organized—the leaf-like body is symmetrical, furnished with a percurrent, filiform midrib, which is a continuation of the stipes or root-stem, and which becomes stem as it is gradually divested of the membraneous border. This takes place with age, and thus old fronds of the same species have often a much branched stem bearing numerous leaves ; all which fronds originated in a single leaf whose stripped midrib was converted into stem, and then put forth new frondlets, to undergo a similar metamorphosis. The only North American genus with filiform fronds is *Graci-*

laria, and one of its commoner species (*G. multipartita*) exhibits every stage between a nearly cylindrical, much branched, bush-like frond and a flattened, laciniated membrane.

The internal structure of the frond presents as many varieties as the outward form. Most of the membranaceous fronds are composed of polygonal cellules, not longer than their breadth, those of the surface stratum frequently tabulated. Sometimes the interior cellules are of large size compared to the exterior, and gradually diminish as they approach the surface of the frond, the outer stratum being composed of minute dot-like cells : in other cases all are nearly of equal diameter. In several the axial or medullary region is occupied by cylindrical cells joined end to end into filaments, which are either solitary, or more commonly bundled together or closely compacted into an internal midrib. In others almost the whole internal substance of the frond is composed of a plexus of such filaments, but this structure is rare in the Order, and confined to some genera of the southern hemisphere. As a general rule, an opaque, inarticulate frond, composed of polygonal, tabulated or roundish cellules, is characteristic of these Algæ.

The colour is of various tints, mostly brilliant ones. Some of the finest and purest carmine, crimson and blood-red hues seen among marine plants, are found in this Order. Others are purple-lake, of greater or less brilliancy ; and a few, chiefly of the filiform kinds, are dull-red, brownish or whitish, tinted with various pale shades of red, or greenish yellow, the latter colours indicating a weak or blanched growth.

The distinctive character of the Order is found in the structure of the sporiferous-nucleus, which consists of a dense tuft of simple or branched, moniliform spore-threads radiating from a cellular placenta fixed in the base of the cavity of an external conceptacle. The conceptacle is of various forms ; bottle-shaped with a prominent orifice, conical, hemispherical or spherical, in the latter cases generally destitute of a pore, and emitting the spores only on the bursting of the pericarp. The walls of this conceptacle are membranous, thick or thin, composed of one or of several strata of cellules. The cavity is generally large, rarely quite filled by the nucleus. The placenta sometimes projects into the cavity so as to fill one-half of the space, and sometimes is but slightly developed. It is always cellular, and generally solid ; sometimes, however, hollowed out beneath. The whole surface is densely covered with vertical or radiating simple or dichotomous spore-threads, each consisting of numerous ellipsoidal or roundish cellules which are gradually converted into spores, the terminal cell ripening earlier than the others.

The *tetraspores* are either tripartite or rarely zone-parted, and are either dispersed over the whole frond, or more frequently collected into definite groups or sori, which are sometimes borne in proper leaf-like processes of the frond. They are always sunk among the superficial cells ; never collected in *nemathecia*, but sometimes lodged in thickened wart-like prominences rising from the membrane.

Many of the genera of this Order are widely dispersed. The *Delesseriæ* and *Nitophylla* are among the most beautiful of leafy sea-weeds, and are found between the parallels of 30° and 60° north and south of the equator, but are more abundant on the European than the American Atlantic coasts. On the North American

Atlantic coast, indeed, *Nitophyllum* is scarcely more than represented. In South America, especially among the indented shores of Terra del Fuego and the islands and channels near Cape Horn both these genera abound, as they also do in New Zealand and Van Dieman's Land. *Nitophyllum venosum* is one of the largest and most splendid of South African Rhodosperms, its brilliant fronds being sometimes two or three feet in breadth. *Delesseria Leprieurii*, which is found in the Hudson river at Westpoint, sixty miles from the sea, and in the estuaries of several rivers of the Southern States, was first discovered in the Sinnamar river, Cayenne ; and has been also found in New Zealand ; a singularly sporadic distribution. *Delesseria quercifolia* of the southern hemisphere is scarcely distinguishable from *D. sinuosa* of the northern ; the southern *D. crassinervia* chiefly differs from the northern *D. Hypoglossum* by the thickness of its midrib ; while *D. ruscifolia* is found in both northern and southern hemispheres. It is curious that *Hymenena* and *Botryoglossum* are found in South Africa and California, the latter genus also at the Falkland Islands. *Grinnellia* is exclusively American, and is one of the most beautiful and characteristic Algæ of the Atlantic coast. *Sphærococcus* is European. Several genera are exclusively from the Southern Ocean, many being Australian. *Gracilaria* is found from the tropics to very high latitudes at either side of the line, and *G. confervoides* and *G. multipartita* are instances of cosmopolitan species.

Of economical species the only ones deserving notice are the *Gracilariæ*, many of which are largely used in India and China, both for food and in the preparation of glues and varnishes. *G. lichenoides* or *Ceylon moss* is a common ingredient in soups and other compound dishes in the East, and is even exported to Europe for similar purposes. It may also be made into jellies and blanc-manges, and is said to be better than *Carrigeen* (*Chondrus crispus*) for all the uses to which that plant is applied. All the *Gracilariæ* readily boil down into a gelatine, and probably are nearly equally valuable.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

Tribe 1. Delesserieæ. *Frond* membranaceous, leaf-like ; the surface cells tabular, polygonal, of large size. *Spore-threads* radiating in a circle from a depressed, basal placenta. *Tetraspores* contained in definite sori.

* *Fronds symmetrical, midribbed.*

I. Grinnellia. *Conceptacles* scattered over the membrane.

II. Delesseria. *Conceptacles* formed in the midrib, or in a lateral vein.

* * *Fronds unsymmetrical, ribless or obsoletely ribbed, or traversed by irregular branching veins.*

III. Botryoglossum. *Frond* thickened in the middle, obsoletely midribbed ; the rib broad, vanishing towards the end of the laciniæ.

IV. Hymenena. *Frond* ribless, traversed by numerous, subparallel, anastomosing veins. *Sori* linear, between the veins.

V. Nitophyllum. *Frond* ribless, either veinless or traversed by obsolete, slender, branching, irregular veins. *Sori* roundish, scattered.

Tribe 2. Sphærococceæ. *Frond* flat, compressed, or cylindrical, cartilaginous or coriaceous, the surface cells roundish, very minute. *Placenta* conical, projecting far into the conceptacular cavity. *Tetraspores* mostly dispersed among the surface cells.

* *Tetraspores oblong, transversely divided (zonate).*

VI. Calliblepharis. *Frond* flat, irregularly cleft, fringed with marginal lobes.

* * *Tetraspores cruciate or triangularly divided.*

VII. Gracilaria. *Frond* terete, compressed or flat.

VIII. Corallopsis. *Frond* constricted at regular intervals or nodoso-articulate.

I. GRINNELLIA. *(Nov. Gen.)*

Frond rosy red, leaf-like, delicately membranaceous, areolated, symmetrical, traversed by a slender, percurrent midrib. *Conceptacles* scattered over the surface of the membrane, bottle-shaped, with a prominent orifice : *placenta* basal, somewhat prominent, crowned with a pulvinate tuft of subdichotomous spore-threads, whose terminal cells are earliest ripened. *Spores* elliptic-oblong or roundish. *Tetraspores* tripartite, immersed in scattered, shapeless, cellular warts.

The remarkable plant which I propose as the type of this genus is peculiar to the eastern shores of North America, along which it ranges from Cape Cod to New Jersey. It abounds in Long Island Sound and New York Harbour, where it constitutes one of the most ornamental features of the submarine flora. It was originally described by the elder Agardh as a species of *Delesseria*, a genus which, as then understood, comprehended almost every Alga with a red, membranous, leaf-like frond, and included also within its limits *Plocamium* and *Stenogramme*. From the restricted genus *Delesseria* it is readily known by the position of the conceptacles, which organs in *Delesseria* are invariably placed either on the principal midrib or on one of its lateral branches. To *Nitophyllum* (*Aglaiophyllum*, Mont.)

our plant has also been referred, but, besides the form of the conceptacle, *Grinnellia* differs from *Nitophyllum* in having a perfectly symmetrical frond, furnished with a single percurrent midrib. In some examples this midrib is very slender, but I believe it may always be distinctly traced, at least in the living plant ; and when the frond is bifid, as it occasionally is, the midrib regularly bifurcates, one arm pursuing each branch. A further characteristic, showing the difference between this midrib and the irregular veins of *Nitophyllum*, is that in *Grinnellia* the midribs of old fronds become gradually stripped and converted into stems, and are then often proliferous ; perfectly formed, ribbed leaflets springing from them. The only other genus of which it is necessary to speak is *Hemineura* (Harv. Ner. Austr. t. 45) but the different nervation and ramification, as well as the position of the conceptacles, afford sufficiently obvious distinctions.

The generic name, Grinnellia, is bestowed in honour of Henry Grinnell, Esq. of New York, whose noble conduct in promoting the search after the missing Arctic Expedition of Sir John Franklin justly entitles him to the respect and gratitude of every man of science. Doubtless there will be other and more worthy memorials ; but yet it seems to me that a beautiful *marine* plant may not unfitly preserve, among the Algologists of America and England, a kindly remembrance of an act of disinterested kindness to wanderers at sea, or let me rather say, a *naval* action to which both Nations may look back with undivided feelings.

1. Grinnellia *Americana.—Delesseria Americana*, *Ag. Sp. Alg.* 1, *p.* 173. *J. Ag. Sp. Alg.* 2, *p.* 681. *Aglaiophyllum Americanum*, *Mont. in An. Sc. Nat.* 3*d. Ser. vol. xi. p.* 63. *Cryptopleura Americana*, *Kütz. Sp. Alg. p.* 872. (Tab. XXI. B.)

Hab. On stones and shells, in four or five fathoms. Abundant in Long Island Sound and New York Harbour. (v. v.)

Root scutate. *Frond* densely tufted, leaf-like, from one to two feet in length, and from one to four inches in width at the widest part, lanceolate, tapering to the base, and usually also to the apex, but sometimes very obtuse and sometimes bifid, delicately membranaceous, waved and often curled at the margin, traversed by a slender, slightly wavy, central nerve, which runs through the frond from the base to the apex, gradually becoming more slender upwards, being as thick as hog's bristle in the lower part of the leaf and as fine as human hair towards the tip. The frond usually consists of a single leaf, or of three or four leaves springing a short way above the base of a common stem ; but when the membrane of the leaf is destroyed by the waves, as often occurs, the old midrib survives and throws out numerous leaflets, and the frond becomes compound. Such secondary leaflets are usually small and densely crowded. *Fructification* of both kinds abundantly produced and scattered thickly over both surfaces of the membrane. *Conceptacles* resembling in form ancient lacrymatories or the wide glass jars in which sulphuric acid is commonly sold, depressed hemispherical, with a more or less prominent orifice, the neck varying in length on the same plant in different conceptacles. The

walls are thin ; the sporiferous nucleus depressed, not filling the cavity ; the *spores* ellipsoidal, the terminal ones ripening much earlier than the rest. *Tetraspores* tripartite, immersed in fleshy, prominent warts, variously lobed and distorted. *Colour* a brilliant lake-red, quickly becoming orange and soon perishing in fresh water. *Substance* very thin. Surface areolated with large hexagonal cells. In drying, it closely adheres to paper.

Plate XXI. B. *Fig.* 1. Grinnellia *Americana*, the *natural* size. *Fig.* 2 and 3, conceptacles of different forms ; *fig.* 4, a conceptacle divided vertically ; *fig.* 5, spore-threads ; *fig.* 6, a wart with tetraspores ; *fig.* 7, the same, divided vertically ; *fig.* 8, a tetraspore ; all more or less *magnified*.

II. DELESSERIA. *Lamour. Grev. ref.*

Frond rosy-red (very rarely purple), leaf-like, laciniate or branched, delicately membranaceous, areolated, symmetrical, traversed by a percurrent midrib. *Conceptacles* sessile on the midrib or on a lateral nerve, globose, without orifice : *placenta* basal, more or less prominent, crowned with a pulvinate tuft of simple or subdichotomous spore-threads whose terminal cells are earliest ripened : *spores* elliptical or roundish. *Tetraspores* tripartite, grouped in definite spots or sori, occupying portions of the frond or of separate leaflets.

With the exception of *D. sanguinea*, Ag. which has a sporiferous nucleus of a very different structure and now forms the genus *Wormskioldia* of J. Agardh, I retain most of the species included in Dr. Greville's restriction of the genus. By Kützing these are arranged in his genera *Phycodrys* and *Hypoglossum*, groups which I regard as subgenera only. The species are numerous and many of them are widely dispersed. Of the following, *D. tenuifolia* and *D. involvens*, now first described, have been found only on the Florida Keys.

Sub-genus 1. Phycodrys, Kütz. *Frond pinnatifid or sinuated.*

1. Delesseria *sinuosa*, Lamour.; stem (at length) elongated, branched, beset with oblong or obovate, deeply sinuated or pinnatifid, toothed, penni-nerved leaves ; nerves opposite. *Harv. Phyc. Brit. t.* 259. *J. Ag. Sp. Alg.* 2, *p.* 691. *Phycodrys sinuosa*, *Kütz. Sp. Alg. p.* 874. *Fucus sinuosus*, *Turn. Hist. t.* 35. *E. Bot. t.* 822.

Hab. Arctic Sea Coast, *Mr. Seeman.* Halifax, *W. H. H.* Boston Bay, *Mr. Emerson, Dr. Durkee, &c.* Newport, *Prof. Bailey, Mr. Olney, &c.*

Frond originating in a single, oblong or obovate, sinuous or deeply pinnatifid leaf, 4—8 inches long and from one to four inches broad, denticulate at the margin, furnished with a strong percurrent midrib, and with opposite, lateral nerves or veins set at an angle with the midrib of about 45°. As the frond grows larger the first formed leaf becomes more deeply laciniated, the laciniæ which were at first little more than denticulations lengthening, widening, and becoming again pinnatifid. The membrane of the older parts decays and the denuded midribs are thickened into filiform, imperfectly winged stems and branches, which bear from their sides and apex numerous leaves resembling the original one. Such specimens are often very bushy and dense. The midribs are usually unbranched, but are sometimes forked. The margin of the frond, which in most cases is merely denticulate, is occasionally bordered with slender, simple or fimbriated lacinulæ, or fringed with great numbers of minute, accessory frondlets. *Conceptacles* hemispherical, formed from the substance of the midrib or of one of its lateral nerves. *Tetraspores* in sori generally lodged in minute marginal leaflets, rarely dispersed over the membrane in patches following the courses of the lateral nerves. *Substance* membranaceous. *Colour* a purple lake, turning rather brownish in drying. It does not adhere strongly to paper.

A specimen from Dr. Durkee has dispersed tetraspores, and unites this species with the *D. quercifolia* of the Southern Hemisphere, which Kützing nevertheless places in a different genus.

In deep water the frond often becomes very narrow, with filiform lobes, produced into long tendrils. Some of my Halifax specimens exhibit this character.

2. Delesseria *fimbriata*, Delapyl.; "leaves of the ribbed, oppositely veined frond obovate, pinnatifid; laciniæ nerveless or having a vanishing nerve, at length separated as proper, linear-oblong, serrated and sinuous leaflets; sori of tetraspores lodged in marginal, acute and acutely toothed fimbriæ, sub-geminate; conceptacles sessile on the parenchyma of the frond." *J. Ag. Sp. Alg.* 2, *p.* 690.

Hab. Newfoundland, *De la Pylaie;* fide *J. Agardh.*

Sub-genus 2. Pteridium, Kütz. *Frond alternately or dichotomously branched, rose-red.*

3. Delesseria *denticulata*, Mont.; frond alternately decompound or irregularly pinnatifid, costate; branches linear, the primary ones alternate, the secondary often opposite, denticulate or fimbriato-ciliate at the margin; the lamina penninerved with opposite, oblique veinlets; sori linear, at each side of the midrib near the ends of the laciniæ. *Mont. in An. Sc. Nat. Ser.* 3. *xii. p.* 223. *D. alata, var. denticulata, Mont. l. c. xi. p.* 62.

Hab. Shores of Labrador, *M. Lamare Piquot,* in Herb. *Montagne.* Brandy Pot Island, River de Loup, *Mr. Allom.* (v. s. in Herb. T. C. D.)

Of this plant I have as yet seen only small specimens, insufficient to enable me to give as full a description as I could wish. The primary frond is four or five inches or more in length, often a quarter to half an inch broad, linear, membranous, traversed by a strong midrib, which gives off at acute angles alternate branches, one running through each primary lobe, and giving off similar branchlets to the succeeding lobes. The lamina throughout is linear, extending at each side of the midrib like a wing, of variable breadth in different specimens, and closely penninerved with microscopic, articulated, obliquely ascending opposite veinlets, each of which runs out into a marginal tooth or lacinula. These marginal denticulations are sometimes minute, sometimes prolonged into linear, acute, ciliæform processes. *Tetraspores* in linear-sori, extending at each side along the midrib, near the apex of the smaller laciniæ. *Axils* acute. *Colour* a purple-rose-red. *Substance* delicately membranaceous.

4. Delesseria *alata*, Lamour.; frond irregularly dichotomous or alternately decompound, costate; branches linear, quite entire at the margin; the lamina (sometimes very narrow) penninerved with opposite, oblique veinlets; sori either at the apices of the segments or in proper leaflets. *J. Ag. Sp. Alg.* 2, *p.* 683. *Harv. Phyc. Brit. t.* 247. *Hypoglossum alatum*, *Kütz. Sp. Alg. p.* 877. *Delesseria angustissima*, *Griff.—Harv. Phyc. Brit. t.* 83. *J. Ag. Sp. Alg.* 2, *p.* 686. (an extreme form, nearly destitute of membrane.)

Hab. Boston Harbour, *Mrs. Mudge*, *Dr. Durkee*, &c. (v. v.)

Frond distichous, two to four inches high or more, much branched, linear, from half a line to half an inch broad, alternately decompound, in a manner between dichotomous and pinnate; branches having a cartilaginous midrib winged at each side with a narrow or broadish membrane, which is occasionally obsolete. My American specimens are not in fruit. *Colour* a bright purple-lake. *Substance* membranaceous. In drying, it does not adhere strongly to paper.

I am not aware of this species being found south of Cape Cod. The specimens from Boston are of small size and very narrow, many of them as narrow as *D. angustissima*, Griff., but in all that I have seen there is an evident wing to the midrib.

5. Delesseria *serrata*, Post. and Rupr.; "stipes winged, compressed, much branched; branches winged, alternately pinnatifid and bipinnatifid; segments linear, costate, serrated at the margin and incised or pinnated in the upper part; sori punctiform, aggregated at each side of the rib along the whole length of the segments. *Post. and Rupr. Illust. p.* 15. *J. Ag. Sp. Alg.* 2, *p.* 696. *Hypoglossum serratum*, *Kütz. Sp. Alg. p.* 876.

Hab. Parasitical on the stipes of *Ptilota asplenioides*, at Unalaschka, *Postels and Ruprecht.*

6. Delesseria *corymbosa*, J. Ag.; "frond subfiliform, dichotomo-corymbose, the upper segments linear, obtusely acuminate, slightly incurved above the axil, very entire at the margin." *J. Ag. Sp. Alg.* 2, *p.* 684.

Hab. Greenland, *Vahl*, fide *J. Agardh.*

7. Delesseria *rostrata*, J. Ag.; "frond subfiliform, pinnato-dichotomous, the upper segments patent, linear, acuminate, very entire at the margin; conceptacles immersed in the terminal segments, thrice as thick as the excurrent beak-like point of the ramulus and shorter than it; sori of tetraspores elongated below the summit of the segments." *J. Ag. Sp. Alg.* 2, *p.* 685.

Hab. Greenland, *Fabricius*, *Vahl.*, fide *J. Agardh.*

Sub-genus 3. Hypoglossum, Kütz. *Frond undivided, oblong or lanceolate, proliferous from the midrib; rose-red.*

8. Delesseria *Hypoglossum*, Lamour.; frond linear-lanceolate, tapering at each end, repeatedly proliferous from the opaque, inarticulate midrib with leaflets of similar form; at length much branched. *Harv. Phyc. Brit. t.* 2. *J. Ag. Sp. Alg.* 2, *p.* 693. *Hypoglossum Woodwardi*, *Kütz. Sp. Alg.* 875. *Var. β. ovalifolium*, J. Ag. leaves oblong, obtuse or subobtuse, not attenuated. *Var. γ. filiforme*, *Menegh.*; leaves exceedingly narrow, much attenuated at both ends.

Hab. Shores of Carolina and Georgia. Charleston Harbour, the three varieties common, *Prof. Gibbes*, *W. H. H.* Anastasia Island, *Dr. Durkee.* (v. v.)

Frond originating in a simple, lanceolate leaf, which, in the American specimens is seldom more than three or four inches long and a quarter inch wide. This leaf is delicately membranaceous, and has a percurrent, slender, inarticulate midrib formed of numerous, closely packed cylindrical cellules. As the plant developes, the midrib throws out at both surfaces numerous similar leaves which in turn bear others; and thus by the repeated production of new series of leaves from the midrib of the older, the plant at length becomes a leafy ball, very dense with crowded foliage. The margin is entire and generally flat. The membrane is composed of polygonal cells of which those next the midrib are nearly equal-sided hexagons, those next them oblong, and those toward the margin gradually smaller and more cylindrical. *Conceptacles* globose, on the midrib. *Tetraspores* in oblong or linear sori, disposed in pairs at opposite sides of the midrib in the smaller leaves. *Colour* a brilliant carmine-lake. *Substance* delicately membranaceous. The plant quickly becomes orange and decomposes in fresh water, and in drying closely adheres to paper.

In var. γ. the leaves are frequently much arched, exceedingly narrow, and tapering to a very slender point. This variety remarkably contrasts with var. β. whose

leaflets are as blunt as those of *D. ruscifolia*. Both varieties accompany the ordinary form in Charleston Harbour, the most northerly station hitherto ascertained for *D. Hypoglossum* in America.

9. Delesseria *tenuifolia;* frond filmy, pale rose-red, broadly linear, obtuse, flat, repeatedly proliferous from the capillary, articulated midrib with leaflets of similar form; at length much branched, fastigiate. (Tab. XXII. B.)

Hab. At Key West, Feb. 1850, *W. H. H.* (v. v.)

Frond originating in a linear, obtuse, perfectly flat leaf, one or two inches long and about two lines in breadth, of extreme tenuity, and furnished with a percurrent, articulated midrib composed of a triple row of cells, of which the central cell is cylindrical and more deeply coloured, the border cells half-hexagonal; the three cells taken together forming a hexagonal areole or articulation of the midrib. This primary leaf emits others from its midrib, and the process is repeated till there results a much branched, fastigiate, globose frond, whose lower branches (the denuded midribs of the primary leaves) are thickened to the diameter of a hog's bristle. I have not seen *conceptacles*. *Tetraspores* occur in very small sori placed one at each side of the midrib near the tips of the young leaves. The substance of the membrane is exceedingly thin and semi-transparent. The cellules toward the midrib are large and polygonal, not regularly hexagonal, but nearly so; those toward the margin oblong or cylindrical, disposed in lines at an angle of 45° with the midrib. *Colour* very pale. In drying, it adheres most closely to paper.

Thin and delicate as are the leaves of *D. Hypoglossum*, those of the present species are much more so, and, when dry, appear as a mere glossy film on the surface of the paper. Under the microscope, it is easily known from *D. Hypoglossum* by the structure of the midrib, and the disposition of the cellules of the membrane, while its pale colour and extreme tenuity sufficiently mark it to the naked eye. In the form of the leaf it resembles *D. ruscifolia*, but in other respects abundantly differs from that strong-growing species.

Plate XXII. B. *Fig.* 1, Delesseria *tenuifolia*, the *natural* size. *Fig.* 2, some leaves, with sori in their apices; *fig.* 3. apex of a leaf enlarged to show the structure of the membrane; *fig.* 4, a tetraspore;—all *magnified.*

10. Delesseria *involvens*; frond filmy, pale rose-red, linear-lanceolate, attenuate, having the apex strongly involute, bordered with oblique bullate undulations repeatedly proliferous from the articulated midrib with leaflets of similar form; at length much branched and fastigiate. (Tab. XXII. A.)

Hab. At Key West, Feb. 1850, *W. H. H., Dr. Blodgett.* (v. v.)

The mode of composition of the frond is the same as in the last species; a pri-

mary leaf, by repeated proliferous development, resulting in a much branched, subdichotomously or secundly divided, globose, fastigiate frond, two or three inches in diameter. Each individual leaf is from half an inch to an inch long and about half a line broad, narrow linear-lanceolate, obtuse at the base, much attenuate at the extremity, which is invariably, on very numerous specimens which I have examined, strongly rolled inwards, and cannot be unrolled without difficulty, immediately rolling up again when released. The margin is quite entire ; within it is a wide border, occupying more than a third part of the breadth of the leaf, composed of narrow cylindrical cells disposed in obliquely ascending lines at an angle of about 45° with the midrib ; and throughout this border the membrane is raised up in oblong undulations having a common direction with the lines of cells, and appearing more strongly coloured than the surrounding parts. The portion of the lamina between the border and midrib is composed of hexagonal cells of which the innermost are largest. The midrib is of the same structure as in *D. tenuifolia*, but formed of larger cellules. In old specimens it becomes, when denuded, thickened into the setaceous stem and branches of the compound frond. *Conceptacles* very convex, more than hemispherical, borne on the midrib. *Tetraspores* in small irregular sori, one at each side of the midrib in the smaller leaves. *Colour* a pale rosy red. *Substance* extremely thin and delicate. In drying, it adheres most closely to paper.

Plate XXII. A. *Fig.* 1. Delesseria *involvens*, the *natural* size. *Fig.* 2. Some leaves, growing proliferously ; *fig.* 3, a leaf, highly magnified to show the structure ; *fig.* 4, *tetraspores* lying among the surface cells ; all more or less highly *magnified.*

Sub-genus 4. Caloglossa, Harv.; *Frond dichotomous, articulato-constricted, rooting at the forks, livid purple.*

11. Delesseria *Leprieurii*, Mont. ; frond livid-purple, linear, dichotomous, either rooting or proliferous at the forks ; the space between each furcation linear-lanceolate ; the ultimate divisions attenuate, bifid at the apex ; midrib articulated, threetubed ; conceptacles nearly spherical, on the midrib ; tetraspores in lines obliquely drawn from the midrib to the margin near the apices of the branches. *Mont. An. Sc. Nat. 2nd ser. vol.* xiii. *p.* 196, *t.* 5, *fig.* 1. *J. Ag. Sp. Alg.* 2, *p.* 682. *Hypoglossum Leprieurii, Kütz. Sp.Alg. p.* 875. (Tab. XXII. C.)

Hab. In tidal rivers, growing on stones, woodwork, or on phænogamous water plants, &c. Discovered in North America by *Prof. Bailey* in the Hudson at West Point, and found more recently in the Ashley and Cooper Rivers, S. Carolina, and in several rivers of Georgia and Florida. Apalachicola, *Capt. Pike.* (106). (v. v.)

Frond one to two inches high, from half a line to a line in diameter, many times regularly dichotomous, constricted at the forks, and traversed by a slender midrib. At the point where the midrib bifurcates, there is generally formed a small rootlet or process by which the plant attaches itself when young. Afterwards, when the

divisions are more erect, these expand into frondlets of similar shape to the original, being at first simple, then forked, and at length repeatedly dichotomous. The midrib is formed of a triple row of cylindrical cells of equal length ; the membrane, of hexagonal cells set in lines extending obliquely from the midrib to the margin, and gradually of smaller size as they recede from the midrib. The *conceptacles* are very rare, and are formed at the expense of the rootlike process at the furcations. They contain within a thin wall strings of conoidal spores borne on a large cellular, basal placenta. *Tetraspores* are more frequently found, and occupy the summits of the leaves, where they are set in obliquely ascending lines. *Colour* a livid purple, fading to green. *Substance* membranous, not very closely adhering to paper in drying.

A very distinct and curious little species of a colour most unusual in this genus, recalling forcibly the colour of the *Bostrychiæ*, plants found in similar situations. I have only seen conceptacles in one or two specimens from Cooper River, but tetraspores are common in Westpoint individuals. These latter are more slender and much more attenuate at the apices than those from Charleston ; a circumstance to be anticipated not merely from the difference of climate, but chiefly from the large admixture of fresh water in the stream of the Hudson at sixty miles above its mouth.

Plate XXII. C. *Fig.* 1. Delesseria *Leprieurii*, the *natural* size. *Fig.* 2, a branch to show ramifications and rootlets ; *fig.* 3, apex of a branchlet, to show the structure ; *fig.* 4, portion with a *conceptacle* formed ; *fig.* 5, vertical section of a conceptacle ; *fig.* 6, spores ; all more or less highly *magnified.*

BOTRYOGLOSSUM. *Kütz.*

Frond purplish red, with an opaque, cartilaginous stem expanding upwards into an irregularly cleft, coriaceo-membranaceous, areolated lamina, traversed in the lower part by an obsolete, vanishing midrib. *Conceptacles* scattered, sub-hemispherical, with a prominent orifice ; placenta basal, crowned with a pulvinate tuft of moniliform spore-threads, whose terminal cells are earliest ripened. *Tetraspores* tri-partite, grouped in definite spots or sori, occupying portions of the frond or lodged in accessory leaflets.

Under this genus I include *Neuroglossum*, Kütz. which merely differs from *Botryoglossum* of the same author in having its tetraspores lodged in intra-marginal sori instead of in foliaceous marginal processes, a character which I consider of such minor importance that I am not sure that it is even of specific value, much less generic. In *Delesseria sinuosa*, *Nitophyllum laceratum*, and even in our *Botryoglossum*

platycarpum both positions of tetraspores occur. Indeed I am by no means convinced that Kützing's *Neuroglossum Binderianum* is *specifically* distinct from *B. platycarpum*.*

Kützing has, as I think unadvisedly, referred *Jeannerettia lobata*, Hook. and Harv. (Ner. Austr. t. 4.) to this place, overlooking the nature of its stichidia, which, in my opinion, clearly indicate an affinity with *Rhodomelaceæ*. However, as the conceptacular fruit is as yet unknown, it may be premature to regard the question decided.

1. Botryoglossum *platycarpum*, Kütz.; sori of tetraspores (generally) lodged in small leafy processes, which either fringe the margin or are dispersed over the surface. *Kütz. Sp. Alg. p.* 881. *J. Ag. Sp. Alg.* 2, *p.* 676. *Fucus platycarpus, Turn. Hist. t.* 144. *Delesseria platycarpa, Ag. Syst. p.* 252. (Tab. XXI. A.)

Hab. Monterey, California, *Mr. Douglas ! Dr. Coulter ! Dr. Sinclair ! Capt. Wilkes !* (v. v.)

Root a large conical disc, throwing out lateral branches. *Fronds* twelve inches long or more, irregularly di-trichotomous or palmate-parted, divided nearly to the base into numerous linear-cuneate laciniæ, which are either simple, or again similarly divided. The lower part of the frond and of its divisions is furnished with a very broad, flat midrib, which spreads over the greater part of the disc. This midrib is cartilaginous and very thick below, but becomes thinner and less defined above, and at length disappears in the upper and wider portions of the cuneate laciniæ. In young fronds the margins of the laciniæ are either deeply crenate or obtusely pinnatifid, the lobes being sometimes deep, sometimes shallow, always very obtuse with bluntish or rounded interspaces. In some specimens the lacinia is merely repand. In old plants the margin is frequently worn away and much jagged, the membrane being reduced to a narrow wing-like border to the broad midrib. In fertile specimens the eroded margin produces a multitude of minute, leaf-like, roundish or lobed processes half a line to a line in breadth, sometimes scattered, but more frequently densely crowded and forming a thick fringe to the segment. In these processes are sometimes found tetraspores immersed in thickened central discs; and sometimes conceptacles. The tetrasporic fruit is most common. A thin slice of the frond shows several rows of muriform cells, of which the central row is of larger size. The outer row alone contains coloured matter. When the membrane is viewed vertically, the surface appears areolated with hexagonal cells, among which may be traced faint indications of internal, branching veins. *Colour* a dark purplish red, becoming browner in drying. *Substance* cartilaginous and thick. It scarcely adheres to paper in drying.

The tetraspores are by no means confined to the marginal leaflets. In some of

* Since this was prepared for the press, I observe that Professor J. Agardh unhesitatingly unites these plants. *Sp. Alg.* 2, *p.* 676.

Douglas' and Coulter's specimens, where the margin is uninjured, they are congregated in large, dense, linear intra-marginal sori, extending along the sides of the laciniæ. Toward the apices the sori are linear, branching and anastamosing, as in *Hymenena*; and all three characters of sorus, the simply intermarginal, the branching and anastamosing, and that placed in the extramarginal leaflet, may sometimes be found on the same root! The existence of such specimens considerably weakens the claims of *B. Binderianum* to specific distinction.

Plate XXI. A. *Fig.* 1. Botryoglossum *platycarpum*, the *natural* size. *Fig.* 2, marginal leaflet, with sorus; *fig.* 3, a tetraspore; *fig.* 4, portion of the areolated surface; *fig.* 5, section through the frond; the latter figures *magnified.*

IV. HYMENENA. *Grev.*

Frond rosy red, expanded, irregularly laciniated, unsymmetrical, membranaceous, areolated, without midrib, but everywhere traversed with numerous prominent, anastomosing, subparallel nerves. *Conceptacles* sessile on the nerves, depressed in the centre (umbilicate), with an orifice; walls very thick; *placenta* basal, slightly prominent, crowned with a depressed tuft of dichotomous spore-threads whose terminal cells are earliest ripened. *Tetraspores* tripartite, in long linear sori lodged in the spaces between the nerves, or in marginal leaflets.

This genus, which is perhaps too closely related to the preceding, chiefly differs in the absence of midrib, and in the numerous anastomosing nerves which supply its place. It is distinguished from *Nitophyllum* by the form of the conceptacle and the thickened substance. The linear disposition of tetraspores occurs in the three genera.

1. Hymenena *fissa*, Grev.; frond palmate, the laciniæ linear-cuneate, undulate, obtuse, erect, very entire at the margin. *Harv. Ner. Austr. p.* 118, *t.* 44. *Kütz. Sp. Alg. p.* 873. *J. Ag. Sp. Alg.* 2, *p.* 674. *Fucus venosus, Turn. Hist. t.* 138.

Hab. Monterey, California, *Capt. Beechey; Capt. Wilkes.* (v. v.)

Root branching. *Fronds* six to twelve inches high, palmate, or irregularly dichotomous, broadly cuneate in outline. *Laciniæ* linear-oblong, simple or lobed, undulate, with an entire margin. Every part of the frond is traversed by closely placed, longitudinal, anastomosing prominent nerves, on which the *conceptacles* are formed, and between which the *tetraspores* are scattered in long lax sori. The

colour when recent is a brilliant purplish lake, reflecting prismatic hues, especially when viewed through water. The *substance* is rather rigid, containing much saline matter and mannite. In drying, it does not adhere to paper.

I do not possess American specimens of this plant, and transfer this description from Ner. Austr. p. 118. An outline drawing of Capt. Wilkes's plant sent to me by Prof. Bailey seems to accord well with my Cape of Good Hope specimens, and I formerly examined one of Capt. Beechey's which appeared also similar.

2. Hymenena *fimbriata*, Post. and Rupr.; frond palmate or multifid, the segments cuneate, deeply lobed, round-topped, traversed by numerous dichotomous nerves which coalesce into a broad compound nerve or imperfect midrib toward the base; the margin of fertile specimens fimbriate with small, roundish leaflets. *Post. and Rupr. Illustr. p.* 15, *t.* 38. *Kütz. Sp. Alg. p.* 873. *J. Ag. Sp. Alg.* 2, *p.* 674. *Hymenena fissa*, *β. marginata*, *Harv. in Bot. Beech. Voy. p.* 407.

Hab. St. Francisco, *Dr. Sinclair*. Golden Gate, *Capt. Pike* (21). Norfolk Bay, *Postells and Ruprecht*. (v. s. in Herb. T. C. D.)

Frond 12—14 inches long, with a linear-cuneate stipe three to four inches long, nearly filled in its lower part with a broad cartilaginous midrib. As the frond gradually widens upwards, the midrib branches into numerous strongly elevated nerves which divide more and more, distributing themselves among the laciniæ of the palmate or multifid membrane. Each segment is broadly linear, half an inch to an inch wide, cuneate, rounded at the top, two thirds or more of its surface occupied by the dichotomously branched, longitudinal nerves, which in some specimens are very strongly elevated, with deep furrows between them, in others less evident and even somewhat obliterated. The margin in young specimens is flat and smooth, in older ones fimbriate with minute roundish processes, which bear the fructification. *Tetraspores* in the thickened marginal lobes, precisely as in *Botryoglossum*. *Structure*, of several rows of quadrate, muriform cells. *Colour* a dark purple-lake. *Substance* rigid. It does not adhere to paper.

This plant has so much in common with *Botryoglossum platycarpum*, that it is hardly natural to place them in different genera.

V. NITOPHYLLUM. *Grev.*

Frond rosy-red or purplish, expanded, irregularly laciniated, unsymmetrical, delicately membranaceous, areolated, without midrib, either altogether destitute of nerves or having towards the base a few irregular, branching, vanishing nerves. *Conceptacles* sessile, scattered, globose, without orifice; *placenta* basal, crowned with

a pulvinate tuft of simple or dichotomous spore-threads whose terminal cells are earliest ripened : spores elliptical or roundish. *Tetraspores* tripartite, grouped in definite spots or sori, variously dispersed over the frond.

This genus is nearly related to *Delesseria*, from which it is only to be distinguished by its unsymmetrical frond destitute of a single percurrent midrib. This character will generally be found sufficient readily to distinguish these groups, but some species of the southern hemisphere exhibit intermediate stages ; as *Delesseria dichotoma* and *Nitophyllum multinerve* which sometimes approach each other *inconveniently* near.

A considerable number of species have been described, which Kützing divides into three genera, *Aglaiophyllum*, *Schizoglossum*, and *Cryptopleura*, distinguished by some differences in the structure of the frond. *Aglaiophyllum* is limited to those species which are altogether nerveless, and have a membrane composed of a single stratum of large cellules: *Cryptopleura* to those in which nerves are more or less obvious, with a similarly constructed membrane : and *Schizoglossum* to such nerveless species as have a membrane composed of more than one stratum of cellules. I do not adopt these genera, because I find the characters untenable. The more or less nervated frond varies even in the same species ; *Schizoglossum Gmelini*, Kütz. for instance, which ought, by generic character, to be nerveless, is frequently abundantly supplied with nerves, much more abundantly than *Cryptopleura Bonnemaisoni* and *C. Crozieri*. The character founded on compound structure is equally nugatory, for *Cryptopleura lacerata*, which is, moreover, the *type* of the genus so called, has a frond constructed of more than one row of cellules, contrary to the generic character. There is, indeed, a most close affinity in structure between *S. Gmelini* and *C. lacerata*, and they cannot be separated generically without violence.

With respect to nomenclature, I prefer retaining the name *Nitophyllum*, under which this genus was first defined, although it may not be constructed on classical principles, to adopting the modern, more classical, but less euphonious, and as I think unnecessary *Aglaiophyllum* of my friend Dr. Montagne. The change of long established names, except in cases of clear necessity, is very objectionable ; and if all names in natural history were to be rejected that are not founded according to strictly classical rules, a large number of new synonyms would soon be added to the copious list already a burden to the science.

One of the more distinctive features of the marine flora of the Atlantic coast of America as compared with that of Europe is, as has been already noticed in our introduction (Part i, p. 24), then early total absence of species of *Nitophyllum*, a genus which abounds on the European coasts, where many kinds are dispersed from the shores of Scotland to those of Spain, and in some places in such profusion that they give the chief character to the vegetation, at certain depths. In contrast to this I can only as yet claim, for the North American seaboard, a few scraps, almost too imperfect for determination. Very different is the case on the shores of South America, beyond the tropic, where the genus flourishes in many fine species, as also

on the South African continent, and along the southern shores of Australia and New Zealand.

1. Nitophyllum *punctatum*. Var. *ocellatum*, Grev. ; frond linear, many times dichotomous, fastigiate, the axils rounded and apices blunt ; sori scattered over the lower segments of the frond. *Harv. Phyc. Brit. t.* 203, *fig.* 1. *J. Ag. Sp. Alg.* 2, *p.* 659. *Nitophyllum ocellatum, Grev. Alg. Brit.—Grev. Scot. Crypt. t.* 347. *Aglaiophyllum ocellatum, Mont.—Kütz. Sp. Alg. p.* 867.

Hab. At Key West, *W. H. H.* (39). Smithville, N. Carolina (?), *Mr. C. Congdon.* (v. v.)

The Key West specimens are about two inches high, exceedingly thin and filmy, divided nearly to the base into repeatedly dichotomous laciniæ, which are about a quarter inch wide. The margin is flat or slightly undulated. The sori are of large size, nearly orbicular, irregularly scattered on the laciniæ. *Colour* a delicate rosy red. *Substance* very soft and flaccid. It adheres most closely to paper in drying.

The specimens examined are very similar to a specimen from Catania, Sicily, preserved in Herb. T.C.D. They are smaller and more delicate in substance than the ordinary British form of this variety ; but in so variable a species no importance attaches to such minor differences.

Mr. Congdon's specimens from the mouth of the Wilmington river are very imperfect and destitute of fructification, but, so far as I can judge, belong to the ordinary form of *N. punctatum*. It is to be hoped that some southern collector may ascertain the fact.

2. *Nitophyllum laceratum*, Grev. ; frond sessile or shortly stipitate, dichotomous, traversed by numerous slender, branching, and anastomosing nerves ; segments linear, variously cleft and lobed, waved at the margin, obtuse ; spots of tetraspores oblong, either intra-marginal or borne on distinct leafy processes of the margin. *Harv. Phyc. Brit. t.* 267. *J. Ag. Sp. Alg.* 2, *p.* 657. *Cryptopleura lacerata, Kütz. Sp. Alg. p.* 870. *Fucus laceratus, Turn. Hist. t.* 68. *E. Bot. t.* 1067.

Hab. Newfoundland, *De la Pylaie*, fide *J. Agardh.* Golden Gate, California, *Capt. Pike* (47). (v. v.)

Frond (in the Californian specimens examined) six to eight inches long, cleft nearly to the base into numerous linear segments half an inch wide below, branched alternately or subpalmatifid above, each ultimate lacinia a quarter inch wide, linear oblong, obtuse, erect, the axils rounded. The whole substance of these specimens is traversed with slender, branching, immersed veins, very visible when the frond is examined with a pocket lens. *Tetraspores* either in linear, intra-marginal, longitudinal sori, or in little, roundish marginal leaflets. *Colour* a livid

purple-red. *Substance* rigidly membranaceous. In drying, it imperfectly adheres to paper.

The specimen examined accords very well with some of those from the west coast of Ireland where this species abounds, and where it exhibits many variations in breadth and ramification. It is easily recognised from all its congeners except *N. Gmelini* by the position of the sori. We have not perhaps sufficient data yet to determine whether *Hymenena fimbriata* be anything more than an extravagant variety of this plant, as I have sometimes supposed.

VI. CALLIBLEPHARIS. *Kütz.*

Frond flat, cartilagineo-membranaceous, dichotomo-pinnate, often margined with wing-like segments or ciliate, formed of two strata of cells ; the medullary cells roundish-angular, longitudinal, of large size, in several rows ; the cortical minute, coloured, in one or two rows. *Conceptacles* sessile on the marginal processes, with a thick pericarp, containing on an elevated basal placenta a dense tuft of fastigiate, moniliform spore-threads forming ellipsoid spores from their upper articulations. *Tetraspores* oblong, zonate, lodged in the peripheric cells of the frond (dispersed), or of the marginal processes.

Separated by Kützing from *Rhodymenia*, on account of the very dissimilar structure of the conceptacular nucleus, and the zonate division of the tetraspores. This last character distinguishes it from *Gracilaria*, from which also it differs by a peculiar habit. The species are of a very deep and brilliant red while growing, but become darker, sometimes almost black, in drying. Their substance is thicker than that of most of the membranous plants of the Order. They are natives of the Northern and Southern Oceans.

1. Callibleparis *ciliata*, Kütz. ; root branching ; frond shortly stipitate, thick, subcartilaginous, dull-purplish red, lanceolate or forked, irregularly pinnated with lanceolate or bifid segments, which are attenuated at the base ; the margin, and often the disc, more or less furnished with subulate processes in which the conceptacles are lodged ; tetraspores collected in cloud-like patches, dispersed over the lamina. *Kütz. Sp. Alg. p.* 755. *J. Ag. Sp. Alg.* 2, *p.* 619. *Rhodymenia ciliata, Grev. Harv. Phyc. Brit. t.* 127. *Fucus ciliatus, Turn. Hist. t.* 70, *fig. a—e. E. Bot. t.* 1069. Var. *β. cirrhata ;* frond very narrow, dichotomous, the apices cirrhiform, repeatedly forked.

Hab. Boston Bay, *W. H. H.* Var. *β.* dredged in Halifax Harbour, *W. H. H.*(v. v.)

My American specimens of this plant are neither numerous nor quite satisfactory. One from Boston Bay is not unlike some of the smaller forms of the species as known in Europe. It is about four inches long, partly dichotomous, partly pinnated with lateral, simple laciniæ, the margin closely fringed with slender, subfiliform, simple or slightly branched processes from a quarter to half an inch in length. The colour is dark red, inclining to purple ; and though it has perhaps more the technical characters of *C. jubata*, its aspect and substance are those of *C. ciliata*.

The Halifax specimens were dredged in deep water, to which circumstance I attribute their peculiarities. They are but two or three inches in height ; one of them is half an inch wide at the widest part, but the usual breadth is from one to two lines or less. The frond is cuneate at base, twice or thrice forked, the apices of the last divisions drawn out into filiform points which are repeatedly forked toward the summit. The margin is fringed with slender lobes, from one to two lines to upwards of an inch in length, in the latter case often dichotomous. Can these be *Rhodophyllis veprecula*, J. Ag.?

VII. GRACILARIA. Grev. J. Ag. ref.

Frond either filiform, compressed, or flat, narrow, carnoso-cartilaginous, dichotomous or irregularly decompound, composed of two strata of cells ; the inner stratum of large, roundish-angular longitudinal cells, more or less filled with granular matter ; the outer of minute, coloured cellules in vertical lines. *Conceptacles* sessile on the branches, hemispherical or conical, with a thick pericarp at length opening by a terminal pore, containing, on an elevated basal placenta, densely tufted, dichotomous, fastigiate, moniliform spore-threads radiating to every side ; *spores* evolved in the upper articulations. *Tetraspores* oblong, cruciate, dispersed among the surface cellules of the branches and ramuli.

This genus, originally proposed by Dr. Greville in his *Algæ Britannicæ*, has been amended by Prof. J. Agardh by the rejection of such species as do not accord with the above characters. It is the same as the *Plocaria* of *Endlicher*, and, to a great extent, as the first section of Kützing's genus *Sphærococcus*. The name *Plocaria candida* was given by Nees von Esenbeck to the Ceylon moss of commerce (*Gracilaria lichenoides?*), and has been extended to the Grevillio-Agardhian genus by Endlicher on the plea that it had the priority in order of publication. But I agree with Professor Agardh in regarding the mutation of an established generic name as being in this instance uncalled for, inasmuch as the name *Plocaria* (which has very little the priority over *Gracilaria*) was given in ignorance of the natural affinities of the plant so-called, Nees believing it to be a lichen ; nor is it very

certain whether the author intended to include in his description one or many species.

The type of this genus is the *Fucus confervoides*, Lin.; a widely dispersed plant, found from the tropics to a high latitude in both hemispheres. *G. multipartita* has also very considerable geographic range. Many of the species, perhaps all, may be reduced by boiling to a tasteless gelatine, which when properly seasoned is palatable and considered wholesome. Some of the tropical species, particularly *G. lichenoides*, yield a very tenacious jelly.

1. Gracilaria *cervicornis*, J. Ag.; membranaceo-cartilaginous, flattish, pinnately decompound; pinnæ linear, dentate, the ultimate ones often filiform, teeth very acute; conceptacles hemispherical, apiculate, on the disc of the upper laciniæ near the margin. *J. Ag. Sp. Alg.* 2, *p.* 604. *Sphærococcus cervicornis*, *Kütz. Sp. Alg. p.* 775. *Rhodymenia cervicornis*, *Montagne. Voy. Bonite*, *p.* 108. *Fucus cervicornis*, *Turn. Hist. t.* 121.

Hab. Gulf of Mexico, *J. Agardh.* (v. s. in Herb. T. C. D.)

Frond six or eight inches long, pinnately much branched, the upper branches more or less dichotomous. Main rachides flat, one or two lines broad, linear; branches not half that breadth, the upper ones very narrow and subterete. Marginal teeth very acute. *Colour* in the dry state dull brownish, with a purple tinge. *Substance* rigid.

Of this plant I possess only South American specimens.

2. Gracilaria *multipartita*, J. Ag.; frond compressed or flat, dull purplish-red, deeply cleft vertically in an irregularly dichotomous or palmate manner; laciniæ linear-wedge-shaped, acute; conceptacles conical, very prominent, numerous, scattered. *J. Ag. Sp. Alg.* 2, *p.* 600. *Harv. Phyc. Brit. t.* 15. *Sphærococcus polycarpus*, *Grev. Crypt. Scot. t.* 352. *Fucus granateus*, *Turn. Hist. t.* 215. Var. *β. angustissima;* frond exceedingly narrow, almost filiform below, compressed, irregularly dichotomous, the apices frequently palmatifid.

Hab. Pacific Coast, California, *Douglas! Capt. Pike!* Massachussetts Bay, *Capt. Pike!* Long Island Sound and New York Harbour, *Prof. Bailey! Mr. Hooper! W. H. H.*, &c. Charleston Harbour, *Prof. Gibbes! W. H. H.*, &c. *β.* at Providence, Rhode Island, *Prof. Bailey! Mr. S. T. Olney!* Longbranch, New Jersey, *Miss Morris.* Charleston, *W. H. H.* (v. v.)

Frond six to twelve inches long, extremely variable in breadth and in its ramification. *Stem* short, at first sub-filiform, compressed, soon expanding into the cuneate base of a flat, multifid frond, somewhat flabelliform in outline, and more or less deeply cleft vertically into numerous laciniæ, varying in breadth from quar-

ter to half an inch or more. These laciniæ are sometimes strap-shaped and nearly simple, or having at one side a few lateral lobes; sometimes they are secundly or alternately multifid; sometimes nearly regularly dichotomous, sometimes palmatifid; and frequently the summits of long, nearly simple lobes are shortly palmate. *Apices* acute, somewhat attenuate, often jagged or irregularly cleft. *Axils* rounded but not very wide. The colour is a dark brownish purple, changing to greenish on exposure. The substance is thickish, cartilaginous, and rather brittle. *Conceptacles* prominent, and generally very abundant on the branches of fertile specimens. In drying, it adheres to paper.

Var. β. which Prof. Bailey finds growing in vast quantities on a sandy bottom, is for the most part so exceedingly slender that it may readily be taken for a distinct species, or even confounded with *G. confervoides*. I have however distinctly traced the connection between the narrowest form and the ordinary one, and this through an extensive series of specimens collected from various localities. Even among Prof. Bailey's specimens from Providence there is considerable variation in breadth and flatness.

3. Gracilaria *compressa*, Grev.; frond succulent, brittle, somewhat compressed, alternately or subdichotomously branched; branches long and mostly simple, tapering to a fine point; conceptacles ovate or subglobose, sessile, prominent, numerous, scattered. *J. Ag. Sp. Alg.* 2, *p.* 593. *Harv. Phyc. Brit. t.* 205. *Sphærococcus lichenoides*, *Grev. Crypt. Scot. t.* 341.

Hab. Gulf of Mexico, at Vera Cruz, *Kützing*, *Sp. Alg. p.* 774. (v. s. in Herb. T.C.D.)

I have not seen any American specimen of this plant. British ones are 6—12 inches long, the branches 1—2 lines in diameter, succulent and brittle, of a beautiful transparent lake-red. Some varieties of *Solieria chordalis* have externally a considerable resemblance to this, but the fructification and the internal structure of the frond are widely different.

4. Gracilaria *confervoides*, Grev.; frond cartilaginous, cylindrical, filiform, irregularly (often very slightly) branched; branches long, subsimple, erect, attenuate; ramuli few, tapering at each end; conceptacles sessile, scattered, roundish or conical. *J. Ag. Sp. Alg.* 2, *p.* 587. *Harv. Phyc. Brit. t.* 65. *Fucus confervoides*, *L. Turn. Hist. t.* 84. *E. Bot. t.* 1668. Var. β. *longissimus*, frond very long, nearly simple, naked or with a few filiform lateral branches.

Hab. Key West, *Mr. Binney*, *Dr. Blodgett* (46). Apalachicola, *Capt. Pike* (36). Var. β. dredged in Charleston Harbour, *W. H. H.* (v. v.)

The ordinary specimens of this variable species are six or eight inches long, as

thick as sparrow's quill, gradually attenuate upwards, more or less branching, sometimes very much branched, irregularly decompound, the branches alternately cleft or subdichotomous. The lesser divisions are mostly distichous, either alternate or secund, and are commonly virgate with a few short lateral ramuli, always attenuate to the acute apex. Axils rounded. *Conceptacles* scattered over all the branches, prominent, as large as rape-seed. *Colour* when growing in deep water a dark, dull purple or brownish, much paler in shallow places, and fading on exposure to a waxy white. *Substance* rigid, cartilaginous.

Var. β. is often six feet long and quite simple, or with a few short lateral ramuli. Its peculiarities appear to result from its place of growth, and intermediate forms connect it with the ordinary much branched varieties.

5. Gracilaria *armata*, J. Ag.; frond robust, cartilaginous, subcompressed, divaricately much branched, distichous; larger branches forked, their divisions multifid; lesser branches and the subulate, curved ramuli generally secund; axils very obtuse; conceptacles ellipsoidal, depressed, scattered on the larger branches. *J. Ag. Sp. Alg.* 2, *p.* 591. *Sphærococcus armatus*, *Kütz. Sp. Alg. p.* 774.

Hab. Key West, *Dr. Wurdeman*, *W. H. H.* (49), *Dr. Blodgett* (58 and 68), *Prof. Tuomey* (15). (v. v.)

Fronds densely tufted, six to eight inches long, as thick as crow's quill below, attenuated upwards, excessively, but very irregularly branched. All parts of the ramification are much divaricated. The main branches either arise several together, from nearly the same point of a short, erect stem, or they divide in an irregularly dichotomous manner, one arm of the fork being frequently suppressed. In this way the branch becomes zig-zag flexuous with secund divisions. The tendency to secund ramification is greater in the minor divisions, almost all the smaller upper branches being secund and set with several linear-subulate, secund, incurved or arching ramuli, the lowermost of which are an inch long, the rest gradually shorter. *Colour* varying from a dark brownish purple to dirty white. *Substance* cartilaginous, but softer than in *G. confervoides*. *Conceptacles* scattered over the branches, not very prominent, longer than their breadth, obtusely conical, with thick walls. In drying, the frond shrinks much, and imperfectly adheres to paper.

6. Gracilaria *divaricata*; frond cartilagineo-membranaceous, succulent, subterete, collapsing and plano-compressed when dry, divaricately much branched, subdistichous; branches irregularly dichotomous, zig-zag or secund, very patent, attenuated to a fine point, copiously furnished with lateral, horizontal, simple or forked ramuli, apices all very acute; fr——?

Key West, *Prof. Tuomey*. (No. 13.) (v. s. in Herb. T.C.D.)

A single specimen only seen by me. *Frond* about four inches long, a line or rather more in diameter at the base, much attenuated upwards, very much branched in a very irregular manner, between dichotomous and secundate, the main divisions frequently secund, and then dichotomously multifid. Principal branches and their divisions distichous. *Ramuli* irregularly inserted, nearly at right angles with the branches, two or three lines long, simple or forked, very acute, the bifid ends divaricating. *Colour* a purplish red, fading to white. *Substance* much more tender than in *G. confervoides*. Fruit unknown.

7. Gracilaria *Poitei*, Lam. ; frond terete, very thick and robust, cartilagineo-corneous, dichotomously decompound, fastigiate, densely branched ; branches erecto-patent, with rounded angles, dichotomo-multifid or furnished with lateral short ramuli, the apices very obtuse, rounded or truncate or sometimes incrassated and distorted ; conceptacles obtusely conical, depressed, scattered on the larger branches. *J. Ag. Sp. Alg.* 2, *p.* 596. *Fucus Poitei*, *Lam. diss. p.* 63, *t. XXXI. fig.* 2, 3.

Key West, rare, *W. H. H.* (48). (v. v.)

Fronds (in my specimens) about three or four inches high, varying in diameter from the thickness of a pigeon's quill to that of a goose quill, shrinking very much in drying, somewhat flabelliform in outline, rising at first with an undivided, erect stipe, then forking and afterwards repeatedly irregularly divided ; the branches opposite, alternate or secund, fastigiate or nearly so, dichotomo-multifid, of nearly equal diameter throughout. *Axils* rounded. Lateral ramuli few, chiefly near the ends of the branches. *Apices* very obtuse, rounded or truncate, sometimes much thickened, and occasionally hollowed out into cups twice or thrice as wide as the branch. *Conceptacles* plentiful, obtusely conical, with a wide mouth opening by a largish pore. *Colour* a livid purple, fading to greenish white. *Substance* carnoso-cartilaginous when recent, rather horny when dry. It does not adhere to paper in drying.

My specimens are more robust than those described by Agardh, but as some are of much greater diameter than others, I do not attribute much importance to this character ; and in most other respects our specimens seem to agree pretty well. One of mine is well supplied with conceptacles.

8. Gracilaria *damæcornis*, J. Ag. ; "frond terete, very thick, carnoso-corneous, decompound-dichotomous, subfastigiate ; branches sub-erect, often incurved, below subsecundly, above subdivaricately ramulose ; ramuli very patent, acuminated from a broader base." *J. Ag. Sp. Alg.* 2, *p.* 598.

Hab. On the Atlantic coast of North America, *J. Agardh.*

Unknown to me.

9. Gracilaria *caudata*, J. Ag.; "frond terete, thick, carnoso-corneous, elongated and laterally ramulose; branches below dichotomo-ramulose, above prolonged, nearly naked, segments acuminate; conceptacles hemispherical, scattered over the whole frond." *J. Ag. Sp. Alg.* 2, *p.* 598.

Hab. Gulf of Mexico, *J. Agardh.*

Unknown to me.

10. Gracilaria? *Blodgettii;* frond cartilagineo-membranous, irregularly dichotomous or alternately decompound, filiform, the axils rounded; branches and ramuli very much attenuated at the base, acute; fructification unknown.

Hab. Key West, *Dr. Blodgett.* (v. s. in Herb. T.C.D.)

Frond five or six inches long, as thick as sparrow's quill, cylindrical or subcompressed, not much attenuated upwards, irregularly much branched, the branches and their divisions either alternate or secund, here and there forked, but not regularly dichotomous. All the branches and their minor divisions and the ramuli, which are few and scattered, taper very much to the base and are attenuated to an acute point; the lesser ramuli are spindle-shaped. No fruit has been detected. A cross section shows a lax medullary stratum, formed of a few very large, distended, thin-walled, irregularly polygonal cells, with some smaller but similar external cells; and a periphery of very minute, vertically subseriate, coloured cellules. *Substance* rather rigid when dry. *Colour* faded in all the specimens yet seen.

A curious plant of doubtful affinity. The ramuli taper to the base fully as much as in a *Chondria*, but there is no articulated polysiphonous axis. The structure is not very different from that of other *Gracilariæ*, and the habit is sufficiently like. I have seen no specimens but those received from Dr. Blodgett, to whom this species is inscribed.

VIII. CORALLOPSIS. *Grev.*

Frond subterete, succulent, articulato-constricted; branches proliferous from the constriction, composed of two strata of cells; the inner of very large, oblong cells, smaller toward the circumference; the outer of minute, coloured cellules in a subsimple row. *Conceptacles* on the primary branches, hemispherical, inflated with a thick pericarp at length opening by a pore, containing on an elevated basal placenta densely tufted, fastigiate spore-threads radiating to all sides; spores obovate, formed in the upper articulations. *Tetraspores* unknown.

Nearly related to *Gracilaria*, from which it chiefly differs in the constricted coral or cactus-like frond.

1. Corallopsis *Salicornia*, Grev.; frond from the base articulato-constricted, di-trichotomous, articulations swollen upwards, club-shaped, three or four branches springing from the summit of each. *J. Ag. Sp. Alg.* 2, *p.* 582. *Sphærococcus Salicornia*, *Ag. Ic. Ined. t.* 8.

Hab. Unalaschka, *Chamisso.*

Frond 5—6 inches long, articulate throughout; the articulations an inch long, very slender at the base, gradually swollen upwards, truncate and slightly hollowed at the apex. From the summit of each joint spring three or four similar articulations, and thus the frond lengthens proliferously. *Substance* when moistened fleshy, when dry cartilaginous.

This curious plant I only know through the figure and descriptions above quoted.

Order V. GELIDIACEÆ.

Hypneaceæ, *Gelidieæ and Solieriеæ*, *J. Ag. Sp. Gen. and Ord. Algarum*, *pp.* viii. ix. xi. *Part of Cryptonemeæ and Sphærococcoideæ*, *J. Ag. Alg. Medit. Endl.* 3*d. Suppl. Harv. Man. Ed.* 2. *&c.*

Diagnosis. Purplish or blood-red sea-weeds, with an inarticulate, cartilaginous or horny, filiform or flattened frond; the axis (at least) composed of longitudinal confervoid filaments; the superficial cellules minute. *Conceptacles* half immersed, prominent towards one or both surfaces. *Spores* attached either to a net-work of slender filaments filling the cavity of the conceptacle, or to a fibro-cellular placenta which either adheres to one wall of the cavity, or runs through its centre, dividing it into two loculi.

Natural Character. *Root* either discoid or branching. *Fronds* almost always tufted, often very densely so, and sometimes forming inextricable matted or pulvinate masses, mostly filiform, either cylindrical or compressed, rarely flattened and somewhat leaf-like, generally much branched. The ramification is commonly pinnate, the frond often many times compounded; sometimes it is irregularly alternate or secund, rarely and very imperfectly somewhat dichotomous; sometimes the

sub-simple branches are densely clothed with irregularly inserted ramuli. In *Suhria* and *Ptilophora* the branches are flattened, traversed by a distinct midrib; in the other genera, they are either cylindrical or compressed; in the latter case thickened in the middle, but without a perfect midrib. The structure of the frond varies considerably in minor points, chiefly in the greater or less development of cylindrical, axial cells. In the typical genus *Gelidium* the whole structure is very dense; the axis composed of a bundle of very slender cylindrical cells, associated in filamentous series, and very strongly soldered together; the periphery, of minute roundish cells formed into vertical filaments; and the intermediate stratum, of seriated cellules having a direction partly longitudinal, but curving outwards towards the periphery. The whole frond, therefore, is constructed of confervoid filaments strongly glued together. In *Eucheuma* the axial and peripheric strata, both well developed, have an arrangement not dissimilar to that of the same regions in *Gelidium*, but the intermediate layer is composed of polygonal cellules forming a honey-combed substance. In *Solieria* the axial stratum is very lax, in the young frond made up of a few distantly set anastomosing and interlaced filaments, but gradually with age it becomes dense; still it never attains to the closely interwoven and firm axis of *Eucheuma*; the peripheric layer is very thin, and the intermediate stratum of honey-combed cells forms the larger portion of the frond. At length in *Hypnea* we find an axis reduced to a few slender filaments or even to a single filament; a periphery of one or two rows of minute cellules, and a frond almost entirely constituted of the honey-combed cells belonging to the intermediate stratum. All these varieties of structure appear to constitute a regular series of successive degradations; and though in comparing together *Gelidium* with *Hypnea* the difference is very great, yet when these genera are looked upon as the extreme types of a natural group in one of which the axial, and in the other the intermediate stratum is in excess, I think it will be seen that they are brought together through *Eucheuma* and *Solieria*, which exhibit axial and intermediate strata in various proportions. In external habit, too, and in substance, there is considerable resemblance between the *Gelidia* and the *Hypneæ*.

If, in like manner, we compare the structure of the pericarp and its contents in these genera, I think we shall find a greater similarity than is apparent on a cursory view; taking, as before, *Gelidium* to express the most developed, and *Hypnea* the least developed type of the Order. In all the genera the spore-threads have few articulations, but one or at most two or three spores ripening on each thread. The spores are sometimes pyriform, sometimes roundish, slightly drawn out at one end, but there is no very marked dissimilarity. The tendency is towards the production of pyriform spores, and is more strongly evidenced in some than in others. The great differences are found in the placentation, and these are so marked as to have led Professor Agardh to place in three Orders the genera which I propose to unite under one. To assimilate the placentation we must bear in mind that the placentæ originate in this group not at the apex of the mass of axial cellules, or of a lateral branch from the axis, as is the case in the *Sphærococcoideæ*, *Laurenciaceæ*, and *Rhodomelaceæ*, but from the sides of the axial filaments themselves, which are continued through the cavity of the conceptacle from its base to its apex. In most

genera of the Order this is obviously the case, the conceptacle arising from a swelling in the middle of a branchlet which is continued beyond the swollen part. In such a case the portion of the substance which constituted the axis of the frond below and above the conceptacle becomes the placenta while passing through the cavity. In *Eucheuma*, where the whole branchlet is encysted, this structure is less apparent, but the filaments which connect the suspended placenta of that genus with the walls of the conceptacle show that the axis does not terminate at the placenta, these filaments being continuations of it. In *Pterocladia* an anomalous structure arises from a different cause, namely from the conceptacular cavity being formed not at both sides of the axis as in *Gelidium*, but at one side only. The result is, that the portion of the axis that bears spore-threads, instead of passing through the centre of the cavity, occupies its inner face as a parietal placenta.

Taking this view of the placentation, the connection between the conceptacles of *Gelidium* and of *Hypnea* may be easily understood. In *Gelidium*, as has been already said, the axis is in excess, while in *Hypnea* it is deficient ; and the placentæ being a development of the axis, we should expect a corresponding relation in the placentation of these genera. And such is the case. In *Gelidium* a dense, fibrocellular placenta, corresponding with the dense axis, divides the conceptacle through the middle of which it runs into two loculi, and bears spore-threads on both surfaces. In *Hypnea* the spore-threads spring from slender, cobweb-like filaments running through the cavity. The structure of *Solieria* is intermediate, there being in the conceptacle of that genus a fibrocellular placenta suspended in the cavity by filaments connected with the surrounding walls, and bearing spore-threads over the whole outward surface. This genus and *Eucheuma*, which has an analogous structure, appear to me to connect *Hypnea* so far with *Gelidium* as to render it advisable to place them in the same group. And possibly *Chætangium* also, when carefully compared with *Pterocladia*, may be found, notwithstanding its remarkable characters, to have a close relationship.

The Gelidiaceæ, as here defined, are remarkable for their beauty, the sportive forms which many species assume, and the wide geographical range of some. *Gelidium cartilagineum* has been noticed for the brilliant variety of the colours which it puts on under the bleaching action of the sun and air, before it fades altogether ; but *Hypnea musciformis*, *Eucheuma isiforme*, and several others are equally brilliant under similar circumstances. *Gelidium corneum*, a most variable plant, is found throughout most parts of the Atlantic and Pacific Oceans, if we except high northern and southern latitudes. It is however both rare and of small size on the eastern coast of North America, though on the Pacific coast it is apparently common and attains large dimensions. *Solieria chordalis*, so abundant on the American shore, is of rare occurrence and rather local in Europe. *Hypnea musciformis* abounds in all tropical and subtropical seas. *Suhria* and *Ptilophora* are only known at the Cape of Good Hope, and *Pterocladia* is one of the most abundant and characteristic of New Zealand Algæ. *Caulacanthus*, associated with *Hypnea* by Professor Agardh, is of doubtful affinity, its conceptacles being unknown ; and I rather incline, with Kützing, to place it near *Endocladia*.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

SUBORDER 1. GELIDIEÆ. *Conceptacles* divided into two cells by a longitudinal axial placenta which bears *spores* on both surfaces.

I. GELIDIUM. *Frond* compressed, rigid, decompound-pinnate.

SUBORDER 2. SOLIERIEÆ. *Conceptacles* having a central, fibro-cellular placenta connected with the walls by slender filaments, and bearing spores on all sides.

II. EUCHEUMA. *Frond* terete, cartilaginous, horny when dry, shrub-like. *Conceptacles* ovate, external, sessile on the ramuli.

III. SOLIERIA. *Frond* terete, succulent, flaccid. *Conceptacles* half immersed in the substance of the filiform branches.

SUBORDER 3. HYPNEACEÆ. *Conceptacles* traversed by arachnoid filaments, to which clusters of spores are attached.

IV. HYPNEA. *Frond* filiform, much branched; branches virgate, clothed with subulate ramuli, their apices often hooked.

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1. GELIDIUM. *Lamour. J. Ag. ref.*

Frond firmly cartilaginous, linear, compressed, decompound-pinnate. *Substance* very compact, composed of three strata; the *axis* of densely interwoven, longitudinal, tenacious filaments, formed of very long, cylindrical cellules; the *intermediate* stratum of small polygonal cellules set in diverging lines, the *periphery* of minute cellules arranged in moniliform filaments at right angles with the axis. *Conceptacles* immersed in the ramuli, prominent on both surfaces, two-celled; the dissepiment longitudinal, connected with the walls of the cavity by slender filaments. *Spores* pear-shaped, on slender funiculi, attached to both surfaces of the medial dissepiment. *Tetraspores* cruciate, immersed among the surface cellules, in subdefined sori near the ends of the ramuli.

The frond is distichous, almost always pinnate, rarely subdichotomous with pinnated lesser branches. It is very narrow, compressed or two edged, rarely quite

cylindrical, of a firm, tenacious substance and densely compacted structure, and when dry is very rigid, almost horny. When growing, the colour is a purplish red of greater or less intensity. On exposure to the air or immersion in fresh water and subsequent drying, this purple changes through various brilliant tints of red, orange and yellow to a waxy or glassy white, retaining a polished surface even when completely bleached. Both kinds of fructification are lodged in the smaller ramuli or pinnules, at some distance below their extremity. The *tetraspores* form little sori, or cloudy patches, and generally occur in slightly expanded, obtuse ramuli, sometimes in the ordinary pinnules and sometimes in minute accessory or special processes of the rachis. The conceptacles whose remarkable structure was first, I believe, correctly described by Prof. J. Agardh (*Advers. p.* 42) are very curious and beautiful microscopic objects. They are formed in the substance of the fertile ramulus, rising towards each of its flat surfaces like little hollow blisters, opposite each other, leaving as a dissepiment between them the flattened axial stratum of the branchlet ; so that it would be more correct to describe them as binate, opposite conceptacles, than as a two-celled conceptacle, which is the apparent structure.

1. Gelidium *corneum*, Lamour.; frond two edged, flat or sub-terete, purplish red, two to four times pinnated ; pinnulæ narrowed at base, linear, entire, obtuse, rarely subacute, those containing the tetraspores club-shaped or obovate, very obtuse ; conceptacles below the apex of the ramulus. *Harv. Phyc. Brit. t.* 53. *J. Ag. Sp. Alg.* 2, *p.* 469. *Kütz. Sp. Alg. p.* 764. *Fucus corneus*, *Huds.—Turn. Hist. t.* 257. *E. Bot. t.* 1970.

Hab. Pacific and Atlantic Coasts. Russian America, *Postells and Ruprecht.* California, *Dr. Coulter*, *Capt. Pike.* Portland, Maine, *Capt. Pike* (54). Red Hook, New York Bay, *Mr. Hooper*, *Mr. Walters*, &c. Sullivan's Island, Charleston, *Prof. Gibbes*, *W. H. H.* (v. v.)

A most variable plant. Dr. Coulter's Californian specimens are three or four inches high, broadly ovate in outline, the lower branches being long, the upper gradually shorter, very densely set and about three times pinnated ; the pinnæ and pinnules patent, tapering to the base, very blunt at the apices, either rounded or subtruncate. The colour is a dark brownish purple. The specimens from New York and Maine are very much smaller, rarely more than an inch and half high, scarcely thicker than hog's bristle, less strongly compressed and more flabelliform in outline, the frond and its principal branches being naked below, and pinnated only above the middle. The Charleston specimens are very similar, but less decompound and the ramuli are not so blunt. These latter are in conceptacular fruit, the conceptacle lodged about the middle of the pinnules, or occasionally even in one of the pinnæ toward the base.

2. Gelidium *serrulatum*, J. Ag. ; "caulescent, stem two-edged, naked below ; frond three to four times pinnate ; pinnules dilated from a narrower base, cuneate-linear, the younger serrulate at the margin, the fertile subsimple, obovate, serrated, curled and twisted, containing numerous tetraspores." *J. Ag. Sp. Alg.* 2, *p.* 472.

Hab. Gulf of Mexico. At Guayra, Venezuela, *Liebman.*

This is said to resemble a robust state of *G. corneum*, from which it is readily known by the serrulated pinnules.

3. Gelidium *cartilagineum*, Grev. ; root much branched ; frond elongate (12—18 inches) two edged, purple or changeable, decompound-pinnate ; pinnæ patent, with rounded axils, linear, very entire, somewhat flexuous, twice or thrice compound ; pinnules mostly opposite ; tetraspores in the incrassated tips of the ultimate pinnules. *Harv. Phyc. Brit. t.* 337. *J. Ag. Sp. Alg.* 2, *p.* 473. *Kütz. Sp. Alg.* 763. *Fucus cartilagineus*, *Turn. Hist. t.* 124. *E. Bot. t.* 1477.

Hab. California, *D. Douglas ; Dr. Coulter ; Lieut. Wood.* (v. v.)

Root a mass of much branched, rigid fibres. *Fronds* in our Californian specimens about twelve inches long, a line in diameter, compressed, two-edged, becoming flatter upwards, three or four times pinnate. *Stems* naked in the lower half, pinnated above the middle ; primary *pinnæ* elongate, patent, alternate or sub-opposite, naked below, pinnate or bi-tri-pinnulate above. All the lesser pinnules issue at very obtuse angles, with a distinctly rounded axil ; they are either alternate or opposite, sometimes quite simple, sometimes decompound. Specimens with *tetraspores* have generally more sub-divided pinnules, the tetraspores being lodged in the thickened, gland-like apices. *Substance* cartilaginous, horny when dry. When growing the colour is very dark brownish purple-red, but on exposure to the air it changes through various brilliant tints of red, orange, yellow, and greenish to a horny white. It does not adhere to paper in drying.

4. Gelidium *Coulteri ;* frond very narrow, plano-compressed, sub-naked below, decompound-pinnate above ; pinnæ close together, distichous, once or twice compounded, pinnules tapering to the base, acute, the fertile ones spindle-shaped, acute- and often aculeate.

Hab. California, *Dr. Coulter.* (v. s. in Herb. T.C.D.)

Densely tufted, three or four inches high, less than half a line in breadth, compressed or two-edged, bare of branches below, closely pinnate above the middle ; the pinnæ one or two lines apart, of various lengths, the lowest longest and most compound, once or twice pinnulated. *Pinnulæ* closely set, distichous, the lower

ones short, subulate, acute, simple, the upper longer and once or twice compounded with similar pinnules. All the pinnules are acute, more or less constricted at their insertion, and many of them denticulate at the margin or set with distichous, tooth-like ramuli, which probably afterwards lengthen into pinnules. The fertile pinnules (containing *tetraspores*) are incrassated in the middle, spindle-shaped, and very generally furnished with marginal spine-like processes. *Colour* a very dark, blackish purple. *Substance* rigid, horny when dry. It does not adhere to paper.

In aspect this plant is most like *G. spinulosum*, J. Ag., but the fertile ramuli are very different.

II. EUCHEUMA. *J. Ag.*

Frond terete or plano-compressed, carnoso-cartilaginous, horny when dry, decompound, usually spiny or tuberculated, solid, composed of three strata ; the *medullary* stratum, of densely interwoven, elongated, anastomosing longitudinal filaments ; the *intermediate*, of several layers of roundish-angular cells, gradually smaller outwards ; the *cortical*, of minute, coloured cellules set in radiating filaments, at right angles to the axis. *Conceptacles* ovate, sessile on the ramuli, furnished with a terminal pore, containing within a very thick pericarp a central, fleshy *placenta* suspended within the cavity, and attached by numerous confervoid filaments to the walls ; *spore-threads* simple or branched, issuing from all sides of the placenta, moniliform, three or four roundish, oblong, or sub-pyriform *spores* formed in each thread. *Placenta* often hollow. *Tetraspores* immersed in the cortical stratum, scattered, zonate.

This genus is formed, by Prof. J. Agardh, for several tropical or sub-tropical Algæ with shrub-like, robust, cartilagineo-corneous, mostly spinous, tuberculated fronds. They were formerly placed either in *Sphærococcus*, *Gracilaria*, *Hypnea* or *Gigartina*, from all which genera, as now understood, they differ in structure and fructification. The conceptacles, however, are only known with certainty in our American species, and have a structure in some respects connecting the *Sphærococcoideæ* (among which Prof. Agardh now arranges this genus) and the *Gelidiaceæ*, as here defined. To me the placentation appears so similar to that of *Solieria* that I am unwilling to separate these genera widely ; while I admit that the moniliform spore-threads show an affinity with *Gracilaria*.

1. Eucheuma *isiforme*, J. Ag.; frond fruticose, very robust, decompound, much branched; branches spreading to all sides, the lesser branches often opposite or

whorled, simple, whorled at short intervals with broadly subulate, acute or obtuse, spine-like ramuli. *J. Ag. Sp. Alg.* 2, *p.* 627? *Sphærococcus isiformis*, *Ag. Sp. Alg.* 1, *p.* 271? *Kütz. Sp. p.* 777. *Hypnea Wurdemanni*, *Harv. MSS.* (Tab. XXIV.)

Hab. Abundant at Key West, *Dr. Wurdeman*, *Dr. Blodgett*, *W. H. H.* Bahia Honda, *Prof. Tuomey.* (v. v.)

Tufts a foot or more in diameter, globose, composed of many stems branching in all directions from a central point. *Stems* of the larger specimens nearly half an inch in diameter at base, soon dividing into several simple branches six or eight inches long, as thick as swan's quills at the base, tapering gradually to the diameter of a crow's quill at the summit, furnished throughout, at distances of two or three lines, with lateral, opposite, whorled, or scattered secondary branches which spread to all sides. These branches are from four to six inches long and in large specimens bear another series of similar branches. They, as well as the main stem, are nodose or swollen at short intervals, the nodes armed with three or four or more verticillate, spreading spines. *Spines* one to three lines long, from a broadly conical base tapering to an acute point ; in old specimens and toward the base of the larger branches obtuse, mamillæform or sub-obliterated. The ends of the branches are sometimes incrassated into a subglobose head, which is either simple or lobed and plaited like the inflorescence of *Celosia cristata.* In fertile specimens the whorled spine-like ramuli are much less regularly disposed. *Conceptacles* borne on the ramuli, one, two or more on each ramulus, variously placed, often terminal, ovate, with a minute pore ; walls very thick, composed of two strata, the inner of many rows of polygonal cells, the outer of radiating moniliform filaments : *placenta* central, suspended in the cavity by numerous, confervoid filaments connecting it on all sides with the walls of the conceptacle, cellular, often hollow within, bearing moniliform, densely crowded, simple or branched *spore-threads* on every side. *Spores* roundish oblong, the terminal one sub-pyriform. I have not seen *tetraspores.* *Colour* when recent a dark full red, becoming scarlet, orange and yellow, and at length semitransparent and horn-like on exposure. *Substance* firmly cartilaginous. In drying, the frond shrinks very much, and if strongly pressed will adhere, though imperfectly, to paper.

The first specimens of this truly noble plant which I received were collected by the late Dr. Wurdeman, and, believing them to belong to an undescribed species, I wished to bestow his name upon it. Afterwards, on carefully reading the character given by the elder Agardh of his *Sphærococcus isiformis*, described from West Indian specimens, it appeared to me that it had many points in common with Dr. Wurdeman's plant, and I therefore communicated by post a small branch of the latter to Professor J. Agardh, requesting him to compare it with that described by his father, and to give me his opinion as to their identity. In reply he informs me that our Key West plant "looks like a different, though nearly related species ; the *S. isiformis* Ag. being a far more gelatino-cartilagineous and coarser plant, with a somewhat different and transparent tint of red, and all the spines obtuse, even the young ones." This opinion was formed on a small branch such as could be sent in

a half ounce letter, but I fear the differences indicated do not amount to specific characters; for I find, among some hundred specimens which have passed through my hands, great diversity in diameter and in the comparative obtuseness of the spines; and the colour depends very much on the longer or shorter exposure to alternate sunlight and rain. Should, however, future observations show that I have confounded two species, the present will, I hope, bear the name of Dr. Wurdeman, its estimable discoverer at Key West.

Plate XXIV. *Fig.* 1. Eucheuma *isiforme*, the *natural* size. *Fig.* 2, part of a branch with conceptacles; *fig.* 3, section of a conceptacle; *fig.* 4, spore-threads; *fig.* 5, semi-section transversely of a branch; *fig.* 6, a longitudinal section through the same; more or less *magnified*.

III. SOLIERIA. *J. Ag.*

Frond cylindrical, subcartilaginous, succulent, fruticose, composed of three strata; the *axis* (or *medullary* stratum) consisting of longitudinal, anastomosing filaments; at first few, afterwards densely interwoven; the *intermediate* stratum of several rows of roundish cells, of which the inner are large, the outer successively smaller and more angular; the *cortical* of two or three rows of minute, coloured cellules. *Conceptacles* immersed in the axial region of the branch, but prominent to one side, the walls formed of a dense plexus of filaments derived from the axis; *placenta* fibrocellular, central, suspended in the cavity by slender filaments connected with the walls: *spores* pedicellate, pear-shaped, covering the whole surface of the placenta. *Tetraspores* transversely parted, (*zonate*) dispersed among the peripheric cellules of the branches and ramuli.

The *frond* is cylindrical, irregularly branched, of a somewhat tender substance, crisp when quite recent, but soon becoming flaccid. When young the axis is exceedingly lax, and the branches are almost hollow, the axial region being occupied by a watery gelatine, through which a few distant, longitudinal, anastomosing filaments are dispersed. Toward the base of the frond and in older specimens the axis is much more dense, and finally, when the growth is fully matured, it becomes a compact plexus filling up the vacant space, and solidifying the branch. The *intermediate* stratum, or the region between the axis and coloured periphery, in like manner, becomes more compound with age, the addition of new cells being made on the outside; and the cells of the innermost row are always of much greater diameter than those of the exterior rows. The *periphery* does not undergo much change. The *conceptacles* appear externally like obtusely conical tubercles with a dark coloured core, scattered profusely over the branches of fertile specimens. A

cross section through one of them shows that they are deeply sunk in the substance of the branch, being wholly formed out of a portion of the axial filaments. The walls are constructed of filaments, derived from the axis, and very densely interwoven together, and invest the sporiferous nucleus on all sides, enclosing it as within a sac. Numerous slender filaments proceed from the inner face of the walls to a central placenta, formed likewise of a dense plexus of filaments. The whole exterior surface of the placenta is densely clothed with pedicellate, oblong or pear-shaped spores, which are either simple, or (perhaps with age) divided transversely into two or more, chained sporules. The tetraspores are of small size, and scattered without order through the surface cells of the branches and ramuli.

In external habit and even in the internal structure of the frond there is a very close similarity between the species of this genus and of *Rhabdonia*, so much so, indeed, that it is impossible to tell, without examining the conceptacular fruit, to which of these genera any individual specimen may belong. The sporiferous nucleus is however very different, but I know of no other characters by which to distinguish *Rhabdonia;* and before I became aware that the American specimens now to be described were identical with the European *Solieria chordalis*, I had referred them without hesitation to *Rhabdonia*. The genus *Solieria* was founded by Prof. J. Agardh on an Alga first found at Cadiz, and which had been referred by the elder Agardh originally to *Sphærococcus;* then to *Delesseria* ; and which was afterwards associated with *Gracilaria* by Dr. Greville, and with *Gigartina* by Dr. Montagne, from all which genera, as now reformed, it is needless to say that it is abundantly different. In external habit it most resembles *Gracilaria (Plocaria)*, and may even be confounded with *G. compressa* ; and before structure of frond and of nucleus were minutely examined it might very well have found a place in the group so called. Though originally observed in Europe, it seems to be much more abundant along the American shore, where its range extends from Long Island to Florida.

1. Solieria *chordalis*, J. Ag.; frond alternately decompound ; lateral branches long, virgate, tapering to the base and apex, and furnished with more or less copious linear-fusiform, acuminate ramuli ; conceptacles copious, half immersed in the branches. *J. Ag. Alg. Medit. p.* 157. *J. Ag. Sp. Alg.* 2, *p.* 723. *Kütz. Sp. Alg. p.* 748. *Delesseria chordalis*, *Ag. Sp. Alg.* 1, *p.* 189. *Gigartina Gaditana*, *Mont. in Webb. Ot. Hisp. t.* 7. (Tab. XXIII. A.)

Hab. Abundant in Long Island Sound, from Cape Cod to New York, *Prof. Bailey*, &c. Longbranch, New Jersey, *Miss Morris.* Charleston Harbour, *H. W. Ravenel, Esq. and W. H. H.* Apalachicola, *T. Drummond*, *Dr. Chapman.* Key West, *W. H. H.* (v. v.)

Frond from six to twelve or fourteen inches long, from half a line to nearly two lines in diameter, much branched but very variable in the ramification. Commonly a subsimple stem is set throughout at short distances with many lateral branches, of which the lowest are longest, the rest successively shorter upwards. These branches

are six or eight inches long, undivided, but furnished with copious lateral secondary branches, which are either similarly decompound once or twice or are furnished with a few scattered, short, erect or spreading ramuli. Sometimes the division is carried on to many sets of alternate branches and ramuli, and then the fronds are exceedingly bushy ; sometimes the frond divides near the base into many virgate branches having a second series of naked secondaries, two to four inches long. All the lesser branches and ramuli are linear-fusiform, tapering to a much contracted base and attenuate to a fine point. *Conceptacles* obtusely conical, half sunk in the branches and ramuli, through which, in fertile specimens, they are plentifully scattered. *Tetraspores* dispersed. *Colour* a dark red, becoming blood red on exposure. *Substance* somewhat cartilaginous, but tender, decomposing in fresh water. In drying, it shrinks much and closely adheres to paper.

I have many varieties of this sportive plant from the American shores. At Fort Hamilton, New York, Mr. Hooper pointed out to me a squarrose form of a very dark colour, more slender than usual, the branches distorted and very irregular and the ramuli either patent or recurved: and Capt. Pike and Mr. Calverley have since communicated many similar specimens from Red Hook. At first sight this form looks very distinct from the deep-water varieties, but the microscopic structure is the same, and I hesitate to separate it specifically. The Apalachicola specimens also have a slightly different aspect from the common form.

Before I had seen the fructification of this species I believed it to be a *Rhabdonia* and had distributed it among my friends as *R. Baileyi*, named in compliment to Prof. Bailey, from whom I received the earliest specimens. It so perfectly resembles in ramification the West Indian *R. tenera*, J. Ag. that except by the structure of the sporiferous nucleus, which Prof. Agardh has examined in the latter, I do not see how they are to be distinguished.

Plate XXIII. A. *Fig.* 1. Solieria *chordalis*, the *natural* size. *Fig.* 2, longitudinal section of a branch, with tetraspores in situ ; *fig.* 3, tetraspores ; *fig.* 4, transverse section through a branch and conceptacle ; *fig.* 5, small portion of the same, to show structure more plainly ; *fig.* 6, spores ; the latter figures more or less highly *magnified.*

IV. HYPNEA. *Lamour.*

Frond cylindrical, cartilaginous, irregularly much branched and set with awl-shaped ramuli. *Axis* consisting of a few slender, longitudinal filaments or filiform cellules, (sometimes wanting) ; *intermediate* stratum of several rows of oblong, polygonal cells, void of endochrome ; *periphery* of one or two rows of minute, coloured cellules. *Conceptacles* hemispherical, without orifice, formed on the ramuli, and containing numerous roundish clusters of pedicellate spores attached to slender, partially anastomosing filaments which traverse the cavity. *Tetraspores* transversely parted (*zoned*), clustered together in swollen ramuli.

The fronds in all the species are much branched, and generally densely tufted, sometimes formed into cushion-like or mossy mats, whence the generic name, derived from *Hypnum*, a well known genus of mosses. The branches are frequently virgate, clothed throughout with awl-shaped, spreading or divaricated ramuli; but there is much difference in ramification between the sterile and fertile fronds of the same species, which makes the determination of these plants often a matter of no small difficulty.

In arranging the American species, I gladly adopt the views of Prof. J. Agardh, who in his recent admirable work (*Sp. Gen. et Ord. Algarum*, *vol.* 2, *p.* 438-455) has revised the genus, casting out Algæ which had been erroneously placed in it, and establishing the true congeners on a more certain basis. And I may take this opportunity of confessing that I have myself been guilty in this matter, having formerly associated with *Hypnea*, *Cystoclonium purpurascens*, a plant of very opposite affinities.

Section 1. Virgatæ. *Sterile* fronds tufted, with virgate branches clothed with subulate ramuli, the older ramuli constricted at the base; *tetrasporiferous* fronds similar, having tetraspores immersed in pod-shaped ramuli; *conceptaculiferous* fronds divaricately much branched.

1. Hypnea *musciformis*, Lamour.; fronds tufted, virgately branched; branches filiform, in the lower part clothed on all sides with subulate ramuli, incrassated and somewhat naked below the apex, which is often strongly hooked inwards; mature ramuli tapering to both ends; those bearing tetraspores incrassated and pod-like in the middle; those with conceptacles spinescent, divaricately branched. *J. Ag Sp. Alg.* 2, *p.* 442. *Kütz. Sp. Alg. p.* 758. *Hypnophycus musciformis*, *Kütz. Phyc. t.* 60, *fig.* 4. *Fucus musciformis*, *Wulf.—Turn. Hist. t.* 127. *Esper*, *t.* 93.

Hab. New Bedford, Massachussetts, *Dr. M. B. Roche.* Sullivan's Island, South Carolina, *Prof. Gibbes*, *W. H. H.* Anastasia Island, *Dr. Durkee.* Key West, *Mr. Binney*, *W. H. H.*, *Dr. Blodgett* (17), *Prof. Tuomey* (19). Pine Islands and Key Biscayne, *Prof. Tuomey* (8, 11, 32). Pacific Coast, at Nootka Sound, *Mr. Menzies*, 1787. (v. v.)

Fronds densely tufted, four to eight inches long, as thick as sparrow's quill below, attenuated upwards, irregularly decompound, generally with an evident stem set with copious, lateral, virgate branches, the lowest of which are the longest, and most of them, as well as many of the secondary branches, incrassated toward the apex and strongly hooked or revolute, sometimes circinate. *Branches* once or twice compound, for three-fourths of their length furnished on all sides with very slender subulate ramuli, one to three lines long, as thick as hog's bristle, acute, at length constricted at the base, patent, densely or laxly set, gradually fewer toward the ends of the branches, where, especially in the incrassated and hooked extremities, they are secund along the outer side of the branch. In some specimens these

ramuli are very densely crowded, so that the branches are completely echinate with them, in others they are few and far between. *Tetraspores* zoned, lodged in pod-like swellings in the middle of fertile ramuli. The *capsuliferous* plant (of which I have not seen American specimens) has the branches everywhere clothed with divaricately branched, spinous ramuli, on which the conceptacles are formed. *Colour* a dark purple, changing to green, or occasionally into a coral red. *Substance* cartilaginous and brittle when recent. In drying, it shrinks and adheres imperfectly to paper.

2. Hypnea (?) *crinalis ;* stem elongated, subsimple ; branches lateral, closely set, virgate, very long, filiform, setaceous, attenuated, straight, having a few scattered, subulate, erect ramuli ; fructification unknown. *Harv. MS. in Herb. T. C. D.*

Hab. California, *Dr. Coulter.* (v. s. in Herb. T. C. D.)

Stems ten to twelve inches long or probably more, as thick as hog's bristle or somewhat thicker, undivided, filiform, furnished throughout at intervals of two or three lines with long, simple, similar branches, 6—8 inches long, about the thickness of horsehair, attenuated, naked or having a few, minute, subulate, erect ramuli scattered along them. *Ramuli* generally two or three lines apart, about a line long, erect or erecto-patent, sometimes copious, sometimes nearly wanting. *Colour* a dark brownish purple. *Substance* cartilaginous. *Fruit* unknown. *Structure* rather different from that of the genus, the peripheric stratum being developed into moniliform strings of cellules.

This has the external habit of *Hypnea*, but till its fructification shall be discovered must remain among the doubtful species, as its structure is somewhat different from the typical. Its cells do not readily expand in water, and muriatic acid dissolves the membranes rapidly, so that I have not been able to obtain as clear a view of the internal cells as I could wish.

Section 2. Spinuligeræ. *Sterile* fronds intricately tufted, branches patent, alternately decompound, and beset with thorn-like ramuli acuminated from a broad, conical base ; *tetrasporiferous* fronds similar, having tetraspores immersed in the base or swollen middle of the ramuli.

3. Hypnea *divaricata*, Grev. ; intricately tufted, alternately branched ; branches not projecting far beyond the tuft, spinulose throughout, less beset toward the straight apices ; spines spreading on all sides, the upper ones sub-secund, patent, simple or compound, acuminated from a broad base ; tetraspores lodged in the tumid bases of the ramuli ; conceptacles three or four together on divaricate, branching ramuli." *J. Ag. Sp. Alg.* 2, *p.* 448. *Kütz. Sp. Alg. p.* 759. (Excl. Syn. Turn.)

Hab. On the shores of the Gulf of Mexico, *Liebman, fide J. Ag.*

I have not seen any American specimens of this plant, which I know only from Australian and Mauritian examples.

4. Hypnea *cornuta*, J. Ag. ? frond decompound, irregularly much branched ; branches widely spreading, both larger and smaller laxly set with scattered, spirally inserted, divaricating, broadly subulate, acute ramuli, which are either simple or forked, and occasionally fasciculate ; ends of the branches sometimes naked, straight." *J. Ag. Sp. Alg. vol.* 2, *p.* 449.

Hab. Key West, *Prof. Tuomey*, (7 and 33[a]), St. Croix, *Miss Dix.*

Frond (in my specimens) three to four inches long, as thick as sparrow's quill, attenuated upwards, very much branched ; the branches alternate or secund, one or two lines asunder, short and long irregularly mingled together, widely spreading with obtuse axils, decompound three or four times ; their apices produced and somewhat bare of ramuli, straight, simple or dichotomous. *Ramuli* more or less copious, scattered along the larger and smaller branches, very patent or divaricate, half a line to a line long, subulate, rising from a broad base, very acute, simple or forked, sometimes two or three from the same point. *Colour* a full dark red. *Substance* cartilaginous.

I have not seen any authentic specimen of Agardh's plant to which I refer the specimens described. His specific character is as follows :—"*H. cornuta ;* cæspitosa alterne ramosa, ramis extra cæspitem parum porrectis, per totam longitudinem laxe spinulosis apice subdenudato-rectiusculis, spinulis quoquoversum egredientibus patentibus, aliis simplicibus a basi latiore acuminatis rigidis, aliis stellulæformibus vivide rubris, capsuligeris rectis spinulis simplicibus obsitis."

5. Hypnea *cervicornis*, J. Ag. ; "intricately tufted, sub-decumbent, divaricately much branched and beset with similarly divaricately branched ramuli ; fertile branches projecting beyond the tuft, more densely ramulose, ramuli spreading on all sides, very patent, mostly ramellose ; those bearing tetraspores tumid above the base, ending in a simple or branching point ; those with conceptacles similar." *J. Ag. Sp. Alg. vol.* 2, *p.* 451.

Hab. Gulf of Mexico, on the Mexican coast, *Liebman, fide J. Agardh.*

Section 3. Pulvinatæ. *Sterile* fronds densely pulvinate, intricately much branched, the branches concrete, cohering ; *fertile* emerging beyond the matted tuft, not entangled together.

6. Hypnea *pannosa*, J. Ag. ; sterile fronds pulvinate, intricately much branched, branches concrete, the exterior ones conical, acuminate ; fertile ones emerging

beyond the tuft, naked at the base, pyramidally branched beyond the middle; branches thick, rather obtuse, those bearing tetraspores sub-unilaterally warted at the base and pod-like below the apex, containing one or more sori. *J. Ag. Sp. Alg. vol.* 2, *p.* 453.

Hab. On the Pacific coast of the Mexican Republic, *Liebman.*

Order VI. SPONGIOCARPEÆ.

Spongiocarpeæ, Grev. Alg. Brit. p. 69. *Part of Cryptonemieæ, J. Ag. Alg. Medit. p.* 81. *Endl. 3d Suppl. p.* 36. *Harv. Man. Ed.* 2, *p.* 131. *Part of Gigartineæ, Kütz. Sp. Alg. p.* 724. *Part of Chondrieæ, J. Ag. Sp. Gen. and Ord. Alg. vol.* 2, *p.* x.

Diagnosis. Brown-red, cartilaginous, fruticose (cylindrical and branching) sea-weeds, almost wholly composed of confervoid, interlaced filaments closely set in firm gelatine. *Sporiferous nucleoli* numerous, globose, many associated together in external, wart-like, amorphous excrescences, formed of vertical, confervoid, filaments. *Spores* large, obconical, radiating from a central point of each nucleolus.

Natural Character. *Root* an expanded fleshy disc. *Frond* cylindrical, firmly cartilaginous, shrub-like, dichotomously branched, composed of three sub-distinct strata of cells, all disposed in filamentous series. The *medullary* layer, occupying more than half the diameter of the frond, is composed of densely packed, longitudinal, elongated, cylindrical, branched and anastomosing filaments, from which are given off towards all sides the filaments of the *intermediate* layer. These are composed of large, elliptical, ovate, or oblong, coloured cells, set in dichotomous filaments which curve outwards, gradually passing from an erecto-patent to a horizontal position. From the ends of these filaments spring those of the *cortical* layer, which are perfectly horizontal, (that is, vertical to the surface of the erect branches), very slender, composed of minute oblong cells formed into dichotomous, fastigiate series. The ends of these filaments, more deeply coloured, constitute the periphery.

In specimens about to produce *spores*, the cortical layer grows out in places into oblong, irregularly shaped *warts* which extend along the branches, sometimes for the space of half an inch. These warts are of a pale, flesh-colour, and wholly

composed of slender, dichotomous filaments, exactly like those of the cortical layer from which they spring. Among these filaments, within the wart, are formed innumerable globose *nuclei* or *spore-clusters*, attached to the filaments; each surrounded by a broad pellucid limbus and consisting of many obconical spores radiating from a minute central placenta. Each *spore* is enclosed in a gelatinous *perispore;* and the pellucid limbus which surrounds the nucleus seems to be formed by the contact of the numerous gelatinous perispores. It is therefore to be regarded as spurious.

Tetraspores are formed in the upper, slightly swollen branches. They are deeply sunk among the peripheric filaments, oblong, and at length cruciately parted.

This Order is founded on a single genus composed of a solitary species, so remarkably distinguished by its fructification from all other known genera of Algæ that it can scarcely be referred without violence to any established group. In external habit of the frond, as well as in internal structure, there is a very close resemblance between *Polyides* and *Furcellaria* (a genus of *Cryptonemiaceæ*), so close indeed that these two genera have frequently been united, and even in the last work of Professor Kützing, an author not remarkable for avoiding generic analysis, *Polyides rotundus* is described as a species of *Furcellaria*. In the fructification of these genera, however, there is so wide a difference that if we are to regard structure of the sporiferous nucleus as a surer guide to natural affinities than structure of frond, we must place them at nearly opposite ends of the systematic arrangement. Another and very opposite affinity for *Polyides* has recently been indicated by Professor J. Agardh, who, in his tabular distribution of the Floridæ, places it among his *Chondrieæ*, the proper type of which group is *Laurencia*. This relationship is no doubt inferred from the size and form of the spores, which may be compared with those of *Lomentaria* rather than with those of any other of the *Chondrieæ;* but in the absence of any indication of nearer affinity between these genera, the mere form of the spores will hardly be thought sufficient. The appearance and structure of the fronds are very dissimilar, and the details of the fructification abundantly unlike. In the *Chondrieæ* (our *Laurenciaceæ*) a single sporiferous nucleus is enclosed in a hollow conceptacle, formed out of the end of a truncated branch, and of the most perfect *type* which the conceptacle attains among the Rhodospermatous Algæ. The contained nucleus is attached to a basal placenta, and therefore terminates the axis of growth. Such a structure is extremely different from what we have above described in *Polyides*, and though very unwilling to multiply Orders, I cannot consent to the ordinal association of genera differing so widely in fructification. In my opinion *Polyides* is more nearly related either to the *Gelidiaceæ* or *Helminthocladieæ*, though scarcely to be placed among either. In the external aspect of the fruit there is much resemblance to *Peyssonnelia*, but much dissimilarity in the nature of the nucleus. So long ago as 1830 Dr. Greville proposed *Polyides* as the type of a separate Order, and I now revert to his views.

I. POLYIDES. *Ag.*

This being the only genus, the character is the same as that of the Order.

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1. *Polyides rotundus*, *Grev. Alg. Brit. p.* 70, *t.* 11. *Harv. Phyc. Brit. t.* 95. *Polyides lumbricalis*, *Ag. Sp. Alg.* 2, *p.* 392. *Spongiocarpus rotundus*, *Grev. Fl. Edin. Furcellaria lumbricalis*, *Kütz. Sp. Alg. p.* 748. *Phyc. Gen. t.* 72. *Fucus rotundus*, *Turn. Hist. t.* 5. *E. Bot. t.* 1738.

Hab. Boston Bay, *Mr. G. B. Emerson*, *Capt. Pike.* Newport, Rhode Island, *Prof. J. W. Bailey.* (v. v.)

Root a spreading disk. *Fronds* several from the same base, two or more inches high, as thick as crow-quill, rising with an undivided stipe to a third or a fourth of the height, then forking, and afterwards repeatedly dichotomous. The axils are rounded, the apices somewhat attenuated and sub-acute, of equal length, giving the frond a fan-shaped outline when spread on paper. *Colour* a very dark red brown. *Substance* cartilaginous. It does not adhere to paper in drying.

Our American specimens are of small size, about two inches high, and are not in fruit. In all characters of structure, &c. they are the same as the European.

Order VII. SQUAMARIEÆ.

Squamarieæ, *J. Ag. Sp. Gen. and Ord. Alg.* 2, *p.* 485. *Part of Spongiocarpeæ*, *J. Ag. Alg. Medit. Harv. Man. &c. Part of Chætophoreæ and Porphyreæ*, *Kütz.*

Diagnosis. Lichenoid, encrusting or horizontally expanded red-brown seaweeds, rooting by the under surface, composed of vertical filaments closely set in firm gelatine. *Spores* in moniliform strings lodged in external wart-like excrescences formed of vertical, confervoid filaments.

Natural Character. This Order is designed to include several anomalous Algæ which agree in a common habit, so far as the frond is concerned, but whose

fructification is yet too imperfectly known to enable us to declare whether the connection be one of analogy or of affinity. Of the eight genera placed here by Prof. J. Agardh, the sporiferous nucleus is known only in one. It is therefore premature to say much of the *natural character* of the Order.

The plants here associated are either gelatinous, cartilaginous, coriaceous or membranaceous expansions, more or less completely attached by their under surfaces to the substances on which they grow. Some few are parasitic on other Algæ, but the greater number adhere to rocks and stones either in the sea or in fresh water streams or rivers. The crust is irregularly orbicular, enlarging by successive additions to its margin, and in the membranous genera is sometimes furnished with concentric lines of growth. In the least developed genus (*Actinococcus*) the whole frond, scarcely more than a line in diameter, is globose, composed of moniliform filaments set in transparent gelatine, and radiating from a common base. Of this type two species, parasitic respectively on *Chondrus crispus* and *Phyllophora Brodiæi*, and which may therefore be expected to occur on the North American coast, have been described. *Petrocelis* and *Cruoria* form widely expanded, skin-like patches of a firmly cartilaginous substance, and dull purple brown or occasionally olive green colour, on the surface of rocks and stones between tide marks in Northern Europe. Like *Actinococcus* they consist of beautifully beaded strings of cells set in gelatine. *Hildenbrandtia* forms thinner and more decidedly membranous, red, or brown-red skins, sometimes merely films, on stones and pebbles, and differs from the preceding as well by the much denser structure of the frond as by having *tetraspores* lodged in minute cavities indicated by dotlike pores scattered over the surface of the crust. In its structure and in this fructification there is some affinity with *Melobesia*, but it wants the deposit of carbonate of lime which distinguishes that genus.

Some or all of the genera just named are probably represented on the North American coast, but in the absence of positive evidence of the fact I can do no more than request the attention of collectors to them. They are all obscure looking, unattractive plants, which may easily escape detection.

I. PEYSSONNELIA. *Dne.*

Frond membranaceous or coriaceous, horizontally expanded and rooting by fibrils emitted from the lower surface, composed of two strata of cellules; the lower stratum of horizontally elongated, cylindrical cellules disposed in radiating filaments cohering laterally into a membrane; the upper of vertically elongated cellules, also arranged in concrete filaments at right angles with those of the lower stratum. Fruit of both kinds lodged in superficial warts composed of vertical confervoid filaments. *Spores* roundish, in moniliform strings. *Tetraspores* oblong, cruciate.

The frond expands horizontally, and is either closely adnate to the substances on which it lies and to which it is attached by means of minute, root-like processes, forming a thin downiness on the lower surface, or it is attached by its lower half only and free at the extremities. It is either orbicular or variously lobed at the margin, the lobes fastigiate, circumscribed by a curved line and more or less fan-shaped, often lying on one another in an imbricate manner, and marked on the upper surface by faint concentric lines of growth. The substance in the smaller species is delicately membranaceous, in the larger, thicker and more leathery. The structure is entirely composed of cylindrical cellules twice or thrice as long as their diameter and firmly set in filaments which closely cohere together and form the membranous or coriaceous substance. These filaments are disposed in two strata. The lowest are horizontal, radiating from a central point in the orbicular fronds, and from the base of the fan-shaped ones ; they form the substratum or basis of the membrane, and by their development determine its limits. From the upper surface of the membrane so formed spring the obliquely vertical filaments of the upper stratum which are closely combined into a crust of greater or less thickness, their length determining the thickness : and as they arise from the radiating filaments of the lower membrane, their terminal cells also form radiating lines on the upper surface.

The fructification is lodged in shapeless, depressed warts irregularly scattered over the upper surface, and formed of vertical confervoid filaments resembling those of the upper stratum but less closely concrete. These warts sometimes contain *spores*, and sometimes *tetraspores*, on separate plants. The *spores* are formed consecutively, one in each cell of the vertical filaments, and are therefore set in moniliform strings, simple or branched according to the nature of the filaments composing the wart. A portion of the wart is thus converted into a sporiferous nucleus, the remainder consisting of barren paranemata which serve the purposes of a conceptacle. The *tetraspores*, in the warts which produce them, are lodged among the bases of the paranemata, several in the same wart, but never placed in strings, each tetraspore being formed of an arrested and transmuted filament. They are pedicellate and at maturity divide into four equal parts placed crosswise.

The type of this singular genus is the *Fucus squamarius* of Gmelin (*Turn. Hist. t.* 244) a native of the Mediterranean, long misunderstood by botanists, and placed by the elder Agardh in *Zonaria*, to which its flabelliform fronds suggested a relationship. Its true characters were pointed out nearly about the same time by Decaisne and Zanardini, both of whom proposed it as the type of a new genus distinguished alike by external habit and by the curious tetrasporic fructification. Montagne, more recently, has described the sporiferous nucleus and thus completed the generic character. To this original species several have since been added, of which the two following are claimed for the North American flora.

1. Peyssonnelia *Dubyi*, Crouan ; frond membranaceous, orbicular or lobed, attached by the whole of its under surface. *Crouan, Ann. Sc. Nat.* 1844, *p.* 368, *t.* 11, *B. Harv. Phyc. Brit. t.* 71. *J. Ag. Sp. Alg.* 2, *p.* 501. *Kütz. Sp. Alg. p.* 691.

Hab. On corals, &c. at Key West, *W. H. H.* (v. v.)

Fronds from half an inch to an inch in diameter, delicately membranaceous, orbicular or reniform, closely applied by the whole inferior surface to the object on which they grow, and to which they are attached by minute rootlets, freely emitted from the membrane. Upper surface finely striate, the striæ radiating from the centre to the circumference, composed of hexagonal, seriated cells. Margin circumscribed, flat. *Colour* toward the centre of the frond dark-red brown, paler and redder toward the margin. I have not seen fruit on the American specimens, which in other respects closely resemble those from the West of Ireland.

2. Peyssonnelia *imbricata*, Kütz.; "depressed, adnate, red-black, coriaceous, irregularly sub-orbicular, lobed, imbricated, rugose, the lobes rounded." *Kütz. Sp. Alg. p.* 694.

Hab. Newfoundland, *Lenormand*, fide Kützing.

Order VIII. HELMINTHOCLADEÆ.

Helminthocladeæ, J. Ag. Sp. Gen. and Ord. Alg. 2, *p.* 410. *Part of Cryptonemeæ, J. Ag. Alg. Medit. p.* 81. *Harv. Man. Ed.* 2, *p.* 131.

Diagnosis. Gelatinous, or gelatino-membranaceous, rosy or purple (cylindrical) sea-weeds, almost wholly composed of confervoid filaments set in loose gelatine. *Sporiferous-nucleus* immersed in the frond, destitute of pericarp, spherical, formed of branching spore-threads radiating from a central point, and bearing minute, roundish spores.

Natural Character. *Root* discoid, little developed. *Fronds* cylindrical or compressed, rarely somewhat flattened, dichotomous, pinnate, or shrub-like, sometimes very much branched, composed wholly or in great part of slender cylindrical or moniliform filaments variously combined together and lying in a transparent gelatine of greater or less consistence. The *axis* of the frond is in all cases formed of a bundle of longitudinal threads, interlaced together and frequently anastomosing, generally compactly united by a rather tenacious gelatine, and giving off, on the outside of the bundle, numerous horizontal filaments which terminate in those of

the periphery. These latter are generally moniliform, either elongated and free one from another, or abbreviated and combined by firm gelatine into a thin membrane. In the suborder *Liagoreæ* they are invested with a secretion of carbonate of lime.

The *sporiferous nucleus* is not contained within any conceptacle, but freely suspended among the threads of the peripheric stratum, by which it is surrounded and involucrated. It consists of a spherical ball composed of innumerable slender, articulated, branching filaments radiating from a common central point, and bearing small, oval *spores* on the ends of the branches. Such is the structure in the first suborder at least. In *Scinaia*, however, I think I have seen, under a highly magnifying power, a cellular membrane as described by Montagne, but denied by Prof. J. Agardh, investing the ball of spore-threads. *Tetraspores* have only been observed in *Nemalion*, where they are formed in the terminal cellules of the peripheric filaments.

The close mutual relationship of the genera here associated will be generally admitted ; with perhaps the exception of *Scinaia*, should the fact of its possessing an external membrane to the nucleus be established. However this may be, the *internal* structure of its nucleus bears a near resemblance to that of the typical genera. The fructification of the *Liagoreæ* is not yet fully known, but the habit and nature of the frond are so similar to those of the *Gloiocladeæ* that there is nothing to invalidate the juxtaposition, at least, of these Algæ. *Dudresnaia*, *Crouania*, and *Gloiosiphonia*, which were formerly arranged among *Gloiocladeæ*, differ essentially in the structure of the sporiferous nucleus, and are now properly placed by Prof. Agardh, the two former in *Ceramiaceæ*, the latter in *Cryptonemiaceæ*. In those Orders they represent, by analogy, the present group.

The geographical distribution of these plants is extensive. Of the five genera yet known four are North American ; two of these, *Helminthora* and *Nemalion*, being also European ; *Liagora* common to all tropical and sub-tropical regions ; and *Scinaia* dispersed north and south of the equator through the Atlantic and Pacific basins. *Helminthocladia* has, as yet, only been found in Europe. None are applied in the arts.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

SUB-ORDER 1. GLOIOCLADEÆ. *Periphery* formed of moniliform filaments lying in rather loose, transparent gelatine.

I. HELMINTHORA. *Axis* laxly cellular within (the interior filaments much distended). *Frond* decompoundly much-branched.

II. NEMALION. *Axis* cord-like, composed of closely interlaced, very slender filaments. *Frond* sparingly dichotomous.

Sub-order 2. Scinaieæ. *Periphery* membranous, very thin, composed of angular cellules.

III. Scinaia.

Sub-order 3. Liagoreæ. *Periphery* formed of moniliform filaments, lying in gelatine and more or less invested with a deposit of carbonate of lime.

IV. Liagora.

I. HELMINTHORA. *J. Ag.*

Frond cylindrical, gelatinous, elastic, much branched, with a filamentous *axis* clothed with a continuous *periphery* of filaments, invested with a loose jelly ; *axis* composed of concrete, parallel, longitudinal, articulated filaments of which the interior are of large diameter compared with the exterior; *periphery* of dichotomous moniliform, fastigiate, horizontal filaments emitted laterally by those of the axis. *Sporiferous nuclei* immersed among the filaments of the periphery, spherical, composed of numerous clavate spore-threads, radiating from a central point. *Tetraspores* unknown.

This genus is proposed by Prof. Agardh for the *Dudresnaia divaricata* of authors whose want of accordance with *Dudresnaia* and affinity with *Nemalion* I had already indicated in the Phycologia Britannica. From *Nemalion* it differs in external habit, but chiefly by the structure of the axis, which is here composed of parallel filaments, concrete together, but not intertwined, and of different diameters, the inner ones being distended, and void of endochrome ; the outer, from which those of the periphery are derived, of much greater tenuity and furnished with colouring matter.

1. Helminthora *divaricata*, J. Ag.; frond filiform, pale red, very much branched, branches opposite or alternate, horizontal, decompound ; ramuli numerous, divaricate, scattered, obtuse. *J. Ag. Sp. Alg. vol.* 2, *p.* 416. *Dudresnaia divaricata, J. Ag. Alg. Medit. p.* 85. *Harv. Phyc. Brit. t.* 110. *Nemalion divaricatum, Kütz. Sp. Alg. p.* 713.

Hab. Key West, *Dr. Blodgett* (No. 60). (v. v.)

Of this plant I have seen but a single American specimen, collected by Dr. Blodgett. It is about three inches long, rather thicker (in the dry state) than hog's bristle, with an undivided stem furnished with several lateral, horizontal branches

which are three or four times compounded, the divisions irregularly alternate, and spreading at right angles. The ramuli scattered, cylindrical and obtuse. *Peripheric* filaments irregularly branched, moniliform. *Nuclei* abundant.

Possibly this may be distinct from the European plant. The axial and peripheric filaments are rather more robust than in British specimens with which I have compared Dr. Blodgett's, but in other respects, internal and external, the two plants nearly coincide. The structure of the nuclei offers nothing peculiar.

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1. NEMALION. *Duby.*

Frond cylindrical, gelatinous, elastic, dichotomous, with a cord-like axis clothed with a continuous periphery of filaments invested in gelatine ; the *axis* composed of elongate, simple, longitudinal, interlaced filaments forming a medullary column, and surrounded by anastomosing threads from which issue the horizontal, dichotomous, fastigiate, moniliform filaments of the *periphery*. *Sporiferous-nuclei* immersed among the filaments of the periphery, spherical, composed of numerous clavate spore-threads radiating from a central point. *Tetraspores* " formed in the terminal cells of the peripheric filaments, triangularly divided, with prominent sporules." (*J. Ag.*)

The fronds are worm-like, either nearly simple or dichotomously branched, of a dull purple colour, and a highly elastic, gelatino-cartilaginous substance, shrinking very much in drying. A cross-section shows a very densely compacted medullary cord or axis composed of interwoven, twisted, slender, longitudinal filaments, giving off obliquely to all sides horizontal, dichotomously-divided branches which form the periphery. The evolution of the frond is thus described by Prof. J. Agardh:—" The different strata of the frond seem to me to be formed in an opposite direction. First, unless I am deceived, the peripheric stratum begins to be developed, from the base upward, by progressive evolution ; some of the branches emitted by the peripheric filaments constitute the peripheric stratum, but others are erected, with a direction more vertical, giving off on their outer side new peripheric filaments, and on their inward side longitudinal filaments. These latter, at first, by an oblique course are directed towards the centre of the axis ; then they take a downward direction, by a longitudinal course. In some respects, therefore, the mode of growth of the Endogenous stem is imitated. The filaments proceeding downwards are inarticulate and cylindrical ; those growing upwards are articulated, and more or less contracted at the dissepiments. So that one may describe the stratification as threefold ; a medullary stratum formed of longitudinal, simple filaments, an intermediate of obliquely horizontal, anastomosing filaments and a peripheric of horizontal, dichotomous, fastigiate filaments."

1. Nemalion *multifidum*, J. Ag. ; frond dichotomous, with rounded axils. *J. Ag. Sp. Alg. vol.* 2, *p.* 419. *Harv. Phyc. Brit. t.* 36. *Kütz. Sp. Alg. p.* 712. (Tab. XXIX. C.)

Hab. Bangor, Maine, *Mr. Hooper.* Newport, *Prof. Bailey.* Narragansett Pier, *Mr. Olney.* Providence, *Mr. Girard*, *Mr. Thurber.* Portland, *Capt. Pike.* Little Compton, *Mr. Geo. Hunt.* (v. v.)

Fronds six to ten inches long, as thick as crow's quills or thicker, worm-like, distantly forked, either regularly dichotomous or sub-palmate, the lesser branches frequently terminating in four or five finger-like lobes. *Axils* rounded. *Apices* very obtuse. *Substance* very elastic, firm. In drying, it shrinks very much, and closely adheres to paper. It is of a dull brownish purple colour.

Plate XXIX. C. *Fig.* 1. Nemalion *multifidum*, the *natural* size. *Fig.* 2, cross section of the frond ; *fig.* 3, peripheric filaments ; *fig.* 4, nucleus separated ; the latter figures *magnified.*

2. Nemalion *virens*, J. Ag. ; "frond compressed, gelatinous, horny when dry, short, repeatedly forked, by degrees attenuated." *J. Ag. Sp. Alg. vol.* 2, *p.* 420.

Hab. Pacific coasts of the Mexican Republic, *Liebman.*

"*Frond* as thick as a pigeon's quill, three inches long, below whitish with a yellowish tinge, green above ; when dry cartilaginous."

III. SCINAIA. *Bivona.*

(*Ginannia*, Montagne.)

Frond terete or compressed, dichotomous, gelatinoso-membranaceous, filled with fluid gelatine, traversed by a fibrous axis from which slender, dichotomous, horizontal filaments radiate towards the membranous periphery which is formed of a thin layer of roundish-angular cells. *Sporiferous nuclei* suspended within the membranous walls of the frond, spherical, (invested with a very thin membranous pericarp ?) composed of innumerable, branching, fastigiate, articulated spore-threads radiating from a central point, and bearing pyriform spores. *Tetraspores* unknown.

The frond in the typical species is rosy red, dichotomously branched and fasti-

giate, always regular in its ramification, but very variable in size and in substance. The widest specimens are always the most delicately membranaceous and gelatinous, the narrower ones being much firmer and of darker colour. The branches are bag-like, and filled with a half slimy, half watery gelatine, which may be squeezed from them, and which, being exuded in drying, causes the filmy remains of the plant to adhere very strongly to paper. The *axis* is composed of a densely interwoven rope-like bundle of very slender, longitudinal filaments, and is much more strongly developed in some specimens than in others ; sometimes being reduced to a few threads, sometimes of considerable diameter, appearing in the dried plant like a strong midrib. A considerable space, filled with gelatine, intervenes between this axis and the membranous periphery, which is, however, organically connected with the axis throughout by innumerable obliquely-horizontal dichotomous filaments, or branches issuing from the axial threads, and terminating in the periphery. These constitute the *intermediate* stratum of the frond. The periphery is composed of one or two rows of roundish, coloured cellules, as it were the apices of the excurrent filaments of the axis, united together into a membrane.

The *sporiferous nuclei*, which are almost always to be found, are abundantly produced in all parts of the frond. They are suspended immediately within the membranous walls, or among the upper dichotomies of the excurrent, horizontal filaments. Professor Agardh describes them as naked, and as such I formerly figured them in Phycologia Britannica ; but a recent examination, carefully made with a high magnifying power, favours the existence of a thin, membranous pericarp, composed of hexagonal cells, as described by Dr. Montagne. On removing some nuclei and pressing them gently between two pieces of glass, I repeatedly have seen a thin torn membrane among the dispersed sporethreads, and which most probably invested the ball. I have not, however, been able, by any other means, to obtain a view of it.

I follow Professor Agardh in adopting the name *Scinaia*, proposed, it would appear, so long ago as 1822, though overlooked until recently. I regret being obliged to lay aside that of *Ginannia*, under which the genus has been generally adopted, but the stringent laws of priority allow me no choice.

1. Scinaia *furcellata*, Bivona ; frond cylindrical, tender, uniformly dichotomous, fastigiate, equal or here and there constricted ; apices obtuse. *J. Ag. Sp. Alg. vol. 2, p.* 422. *Ginannia furcellata*, *Mont.—Harv. Phyc. Brit. t.* 69. *Kütz. Sp. Alg. p.* 715. *Myelomium furcellatum*, *Kütz. Phyc. Gen. t.* 73, *f.* 1. *Ulva furcellata*, *E. Bot. t.* 1881.

Hab. Newport, Rhode Island, *Prof. Bailey.* Key West, *W. H. H.* (v. v.)

Frond two to four inches long or more, cylindrical, varying much in diameter, sometimes as thick as a swan's quill and sometimes not thicker than a sparrow's quill, many times forked, regularly dichotomous, level-topped, the branches when displayed having a definite, semicircular outline. Lower dichotomies sub-distant, upper successively closer together. *Axils* and *apices* blunt. *Substance* more or less

gelatinous. *Fructification* generally present. *Colour* a fine rosy or lake-red, becoming darker and browner in drying.

The largest of my Key West specimens is quarter of an inch in diameter, most of the others scarcely the tenth of an inch.

This species, first noticed on the east coast of England about fifty years ago, has been brought from very distant localities. It is found in Europe from the Baltic Sea to the shores of Spain, and in the Adriatic ; in Africa at the Cape of Good Hope ; in Tasmania and New Zealand ; and on the coasts of Chili and of the Sandwich Islands.

IV. LIAGORA. *Lamour.*

Frond terete or compressed, dichotomous or pinnate, at length coated with a calcareous deposit, with a filamentous axis and continuous stratum of peripheric filaments ; *axis* consisting of elongated, branching, interlaced, longitudinal filaments ; *periphery* of horizontal, articulated, moniliform, much branched filaments. *Fructification* imperfectly known.

Under this genus are placed several Algæ of a gelatinous substance, formed of interlacing, longitudinal and horizontal confervoid filaments, and coated at maturity with a crust of carbonate of lime, organically deposited by the cellules of the frond. In consequence of this calcareous coating, Lamouroux placed the genus among the Tubularian Zoophytes ; an association which could only be made on the most cursory observation of dried specimens. The elder Agardh therefore early restored the genus to the Florideous Algæ, to which group their colour indicates an affinity, while the structure of the frond is so very similar to that of *Helminthora* or *Nemalion*, that, even in ignorance of the fructification, we should be disposed to place them near those genera. The only other association which needs to be spoken of is that proposed by Decaisne, who refers *Liagora* to his *Batrachospermeæ*. Against this arrangement the chief obstacle is that the *Batrachospermeæ* are fresh water Algæ and of the Chlorospermatous division, while *Liagoræ* are marine and Rhodospermatous. It is true that some of them turn green in drying, but they also at the same time partially decompose, and we know that almost any red marine Algæ will in decay assume a green tinge. On the other hand *Thorea*, and even some species of *Batrachospermum* itself, become violet when dry. I have not seen fructification, which Prof. J. Agardh describes as " protruding beyond the calcareous crust ; and composed of innumerable club-shaped, naked spore-threads radiating from a central point."

All the species are natives of the warmer parts of the sea, particularly of coral

reefs and islands. Of the described species four or five occur in the Mediterranean, and one extends along the Atlantic coast of Europe as far north as Brest, the highest latitude attained by the genus. Probably many remain to be described, but require careful attention in a living state for their correct determination, as all change considerably, and some can scarcely be recognized in a dried state. Several reputed *Galaxauræ* of the section *Microthoe*, perhaps all the species of that section, appear to me to belong to *Liagora*, but I have not had good opportunities of examining them.

* *Fronds covered with a continuous calcareous deposit.*

1. Liagora *valida* ; frond robust, repeatedly dichotomous, fastigiate, with rounded axils, becoming when dry whitish with red-brown apices, covered with a thin continuous, calcareous deposit ; apices obtuse, not attenuated ; filaments of the periphery repeatedly forked, fastigiate, moniliform, their cells elliptical. (Tab. XXXI. A.)

Hab. Sand Key, Florida, *W.H.H.* (v. v.)

Fronds tufted, two to three inches long, half a line in diameter, terete when fresh, becoming compressed in drying, repeatedly and nearly regularly dichotomous from the base, the axils rounded, the apices obtuse and divaricating, not at all attenuate. *Calcareous* coat thin, but uniformly spread, completely coating the peripheric filaments in the lower part of the frond, less dense near the ends of the branches, allowing the tips to project beyond it. When dry, the coated portion of the frond assumes a chalky whiteness. On removing the lime by acid, the peripheric stratum resembles that of *Helminthora*. The peripheric filaments are three or four times divided, the articulations of equal diameter throughout, the lower ones sub-cylindrical, the upper successively more elliptical and contracted at the dissepiments. The colour when recent is a pale pinky red, which is partially retained in the microscopic view of the re-moistened plant.

This may have been previously described as a *Galaxaura* of the section *Microthoe*, but I am not possessed of materials sufficient to decide the point.

Plate XXXI. A. *Fig.* 1. Liagora valida, the *natural* size. *Fig.* 2, portion of a branch from which the lime has been removed ; *fig.* 3, axial and peripheric filaments ; *fig.* 4, a peripheric filament ; *fig.* 5, apex of the same ; the latter figures more or less *magnified*.

2. Liagora *pinnata* ; stem sub-simple, closely set throughout with lateral branches, which spread toward every side ; branches pinnate, or sub-bipinnate, the pinnæ frequently opposite, the pinnules irregularly placed, cylindrical, obtuse, spreading ; calcareous deposit thin, continuous ; apices reddish-brown when dry ; filaments of the periphery not much branched, irregularly dichotomous, fastigiate, not beaded, their cells about twice as long as broad, cylindrical. (Tab. XXXI. B.)

Hab. Sand Key, Florida, *W. H. H.* (v. v.)

Frond about three inches long, about as thick as sparrow's quill, with a leading stem set at short intervals with branches an inch or two in length, spreading to all sides, the lowest short, the middle ones longest, the rest shorter upwards. *Branches* mostly pinnated, sometimes forking or sub-bipinnated, the larger ones occasionally more compound, all the divisions very patent. *Ramuli* opposite or alternate, cylindrical, obtuse. When dry, the frond, as usual, becomes compressed and loses colour; the older and more coated parts turn white, the younger change to a dark reddish brown; under the microscope exactly a "pepper and salt," or mottled with specks of white and brown. The peripheric threads are simpler, less regularly forked, and more cylindrical than in the preceding species, their cells being scarcely constricted at the ends. *Colour* when growing, a pale pinky red. *Substance* cartilagineo-gelatinous. In drying, it closely adheres to paper.

Plate XXXI. B. Fig. 1. Liagora *pinnata;* the *natural* size. *Fig.* 2, part of a branch; *fig.* 3, peripheric and axial filaments; *fig.* 4, a peripheric filament; *fig.* 5, apex of the same; all more or less *magnified.*

3. Liagora *ceranoides*, Lamour.; "frond compressed, canaliculate at one side from the base to the apex, dichotomously branched, fastigiate, clothed with a continuous crust, apices forked, sub-diverging, the younger ones purplish red." *J. Ag. Sp. Alg., vol.* 2, *p.* 426.

Hab. Vera Cruz, *Liebman.*

It must be borne in mind that the above description has been made from dried specimens, and the *compressed, canaliculate frond* may refer only to the dried plant. I am not acquainted with this species, which is said to agree with *L. viscida* in size and ramification.

* * *Fronds* covered with a powdery calcareous deposit.

4. Liagora *leprosa*, J. Ag.; frond terete, (compressed when dry) repeatedly dichotomous, fastigiate, with rounded axils, covered with a pulverulent calcareous deposit, whitish when dry, with the ends of the branches greenish; filaments of the periphery flabelliform in outline, excessively di-trichotomous, moniliform, the ultimate cellules very minute. *J. Ag. Sp. Alg.* 2, *p.* 427. *Kütz. Sp. Alg., p.* 539. (Tab. XXXI. C.)

Hab. Vera Cruz, *Liebman.* Sand Key, *W. H. H.* (v. v.)

Frond tufted, one to two inches high, as thick as sparrow's quill, terete when recent, compressed or channelled at one side when dry, repeatedly and very regu-

larly dichotomous from about an inch above the base, without lateral branches; the segments fastigiate, sub-corymbose. *Axils* all very obtuse. *Apices* blunt, rounded or emarginate in the dried specimen. On removing the calcareous matter with muriatic acid, the axis is seen to be composed of many very slender, cobwebby, hyaline, long-jointed, cylindrical filaments, from which issue laterally toward the outside the horizontal peripheric filaments whose apices constitute the continuous surface of the frond. These are pedicellate or unbranched for a third of their length, then forked, and afterwards excessively di-trichotomous, all the branches fastigiate, composed of elliptical or globose cells, strung together like the beads of a necklace; the ultimate cellules exceedingly minute, and appearing dot-like even under a high magnifying power. *Colour* when growing a pale pinky red, soon changing on exposure, and fading altogether during the process of drying. The dried plant is coated with a powdery, calcareous deposit, and white, except the ends of the branches, which become green. The substance is soft, between gelatinous and cartilaginous, and the plant rapidly decomposes. In drying, it adheres closely to paper.

I should not have ventured to refer my specimens as above, had I not received a specimen of Professor Agardh's plant from that author himself, and found it to agree with my Sand Key specimens in every particular. The differences in our descriptions arise from his having seen and examined dried specimens only.

Plate XXXI. C. *Fig.* 1, tuft of Liagora *leprosa*, the *natural* size. *Fig.* 2, portion of a branch; *fig.* 3, axial and peripheric filaments from the same; *fig.* 4, part of one of the lesser branches of a peripheric filament; *fig.* 5, apex of a division of the same; the latter figures more or less highly *magnified.*

5. Liagora *pulverulenta*, Ag.; "frond compressed, sub-canaliculate, terete above, dichotomous, with many lateral proliferous branches, covered with a powdery crust; the apices divaricate, obtuse; the younger ones purpurascent." *J. Ag. Sp. Alg. vol.* 2, *p.* 427. *Kütz. Sp. Alg. p.* 538.

Hab. Vera Cruz, *Liebman.*

I am not acquainted with this species.

Order IX. WRANGELIACEÆ.

Wrangelieæ, J. Ag. Sp. Gen. Ord. Alg. vol. 2, *p.* 701. *Part of Ceramiaceæ, J. Ag. Alg. Medit. p.* 69. *Endl. 3d. Suppl. p.* 34. *Harv. Man. Ed.* 2, *p.* 156. *Part of Callithamnieæ, Kütz. Sp. Alg. p.* 664.

Diagnosis. Rose-red, filiform, articulate or inarticulate sea-weeds, furnished with a monosiphonous, articulated axis. *Sporiferous-nucleus* naked, formed of branching spore-threads radiating from a fixed point, or whorled round minute lateral ramuli. *Spores* pear-shaped, formed in the terminal cell of the spore-thread.

Natural Character. *Root* a small disc. *Fronds* filiform, much branched, alternately decompound or decompound-pinnate, the branches either opposite or alternate, articulate or inarticulate, the inarticulate species traversed by an articulated, monosiphonous axis, round which smaller stratified cellules are gradually deposited. The younger portions of the frond in the typical genus are always confervoid, or composed of a single row of cellules placed end to end in an articulated thread. The cell-walls are thick, pellucid, and of a softish substance, soon decomposing in fresh water. The endochrome, when recent, is generally a brilliant rosy red or purple-lake tint, which is sometimes partially preserved in drying, but frequently it becomes browner in drying, and in several species changes to a dark brown or even black. This a good deal depends on the state of individual specimens, as the shade of colour varies in the same species.

The *sporiferous nucleus* is not enclosed within any conceptacle, nor is it immersed in the frond, but exposed wholly naked, or at most surrounded with involucral ramuli, which close over it without contact. It consists of many branching spore-threads, either springing in a globose cluster from the end of a shortened branch, or whorled round the middle portion of minute, lateral ramuli. These spore-threads at maturity bear on the branches solitary, pear-shaped spores, formed by a transmutation of the terminal cells. The *tetraspores* are only known in some species of *Wrangelia*. They, also, are naked, scattered along the monosiphonous, confervoid ramuli, each tetraspore being formed of a ramulus shortened to a single cell.

At present this Order consists of two genera, one removed from the Ceramiaceæ, the other from the Gloiocladeæ. In the structure of the frond and in the whole external habit, *Wrangelia* so perfectly resembles a Ceramiaceous plant that some of its species have been, at different times, referred either to *Griffithsia* or to *Callithamnion*, and so far as structure may indicate affinity there is a near agreement between *Callithamnion* and *Wrangelia*. But here the relationship ends, for the nature of the

sporiferous nucleus in these genera is widely different. In *Callithamnion* the nucleus is a naked *favella* or encysted cell filled with a mass of disconnected spores originating in the repeated division of the endochrome of the mother cell; in *Wrangelia*, as already described, it is a tuft of spore-threads bearing pear-shaped pedicellated spores. If therefore the structure of the nuclei is to be our guide in arrangement, the resemblance of *Wrangelia* to *Callithamnion* is one of analogy only, these genera representing each other in the series to which they respectively belong.

Naccaria, which is associated with *Wrangelia* by Prof. J. Agardh, appears at first sight to have little affinity with it, differing especially in the wholly inarticulate frond. This character is, however, of minor importance, as is seen in *Ceramiaceæ*, where some genera are inarticulate; or even in *Wrangelia* itself, where the older portions of the stem and branches in several species are opaque. A comparison of the sporiferous threads of *Naccaria* with those of *Wrangelia* will show an agreement in essential structure; and the differences in the nuclei are chiefly in the arrangement of the parts, the spore-threads of *Wrangelia* radiating from the end of a truncated branch, those of *Naccaria* being whorled round the ramuli. I think, therefore, a true relationship between these genera has been established.

WRANGELIA. *Ag.*

Frond filiform, decompound-pinnate, articulated, one-tubed; the *internodes* naked or coated with minute cellules, the *nodes* clothed with opposite or whorled, byssoid, articulated ramelli. *Sporiferous-nucleus* terminal, involucrated, the involucre formed of byssoid ramelli, the nucleus composed of a dense tuft of radiating pyriform spores, formed of the terminal cells of the spore-threads. *Tetraspores* naked, sessile on the sides of the ramuli, spherical, triangularly divided.

In some species the frond is pellucidly articulate throughout, each internode formed of a single, cylindrical, thick-walled cell, filled with a brilliant carmine endochrome, and separated from the internodes above and below it by a hyaline diaphragm. In others the younger parts of the frond alone exhibit this perfectly articulated structure; the older portions being more or less fully coated with a stratum of small cellules; and in some other species the whole of the stem and branches are rendered opaque by these accessory cells, and the articulated structure of their fronds can only be ascertained by a careful dissection. In all the species the ultimate ramelli, which are often of a byssoid tenuity, are single-tubed and pellucidly articulate, and they generally spring from each node throughout the frond. They are minute, pinnately or dichotomously compounded, mostly whorled, but sometimes distichous, and, in that case opposite each other. It frequently

happens that the ramelli are longer at one side of the stem than at the other, the long and short filaments alternating from node to node.

The *sporiferous-nucleus* generally terminates a short branch. It is destitute of any proper coating or pericarp, but is surrounded and often closely invested by a whorl of byssoid ramelli. It consists of a tuft of spore-threads, radiating from the apex of the branch, and bearing terminal, pear-shaped spores. The *tetraspores* are scattered along the ramelli, of whose metamorphosed branches they are formed; they are spherical or ellipsoidal, sessile, and triangularly divided.

Of this genus, which was originally founded on our *W. penicillata*, several species are now known, dispersed through the Atlantic and Southern Oceans. Some of them have the external habit of *Griffithsia*, others of *Callithamnion*, and others of *Dasya*, genera to which, in their fructification, they have but little affinity. In the nature and position of the tetraspores, indeed, there is a close resemblance between *Wrangelia* and *Callithamnion;* but the structure of the sporiferous-nucleus obliges us to place them widely apart. From *Dasya* the monosiphonous frond affords an easily-seen distinction, independently of fructification.

1. Wrangelia *penicillata*, Ag.; frond ultra-setaceous, decompound-pinnate, distichous, the stem and larger branches corticate, opaque, the lesser branches articulate; ramelli whorled round the nodes, repeatedly dichotomous, of nearly equal diameter throughout, obtuse, their articulations contracted at the dissepiments, 4—8 times as long as broad. *J. Ag. Sp. Alg.* 2, *p.* 708. *Kütz. Sp. Alg. p.* 664. (Tab. XXXIV. B.)

Hab. Key West, very abundant. *W. H. H., Dr. Blodgett, Prof. Tuomey*, &c. (v v.)

A most variable plant in aspect, according to the greater or less development of the primary and secondary branches; but when this is borne in mind, easily recognisable under all its forms. The branching is uniformly distichous, and decompound-pinnate. Sometimes it is nearly simply pinnate, with few and distant pinnæ; sometimes a few alternate long branches, or primary pinnæ, are set with minute alternate pinnules 2 or 3 lines long; sometimes the frond is closely and regularly thrice or four times pinnated, each branch having an ovate or lanceolate outline and fern-like aspect; and between these extreme forms there are endless varieties. In all cases the branches are whorled at every node with very soft, repeatedly dichotomous, confervoid filaments, which are very frequently longer at one side of the branch than at the other. The articulations of these ramelli are 4 to 6 or 8 times as long as broad, swollen upwards, the dissepiments much contracted, and the terminal cell obtuse. The stem and larger branches are coated with small cellules, and thus appear opaque and inarticulate; in the smaller branches the cellular coat is less uniformly spread, and the ultimate or youngest branches are pellucidly articulate. The *sporiferous nucleus* is globose, and usually terminates the shorter branches. It is surrounded by an involucre composed of copious

ramelli, which often overtop it, and completely hide it. *Antheridia* frequently occupy the position of tetraspores. They consist of minute spherical tufts of dichotomous, radiating filaments attached to the sides of the ramelli. I have not found *tetraspores* on the American specimens. When quite fresh the frond is of a beatiful rosy red, and sometimes this is partially preserved in drying ; but more commonly, especially if the specimen be suffered slightly to decay, it turns dark brown or blackish in the drying process, and stains the paper of the same colour. The *substance* is very flaccid and tender, soon decaying in fresh water.

I was at first disposed to regard our American plant as distinct from the European *W. penicillata*, and had proposed to call it *W. filicina*, but a careful comparison of numerous specimens has shown that the distinctions on which I had relied are insufficient.

Plate XXXIV. B. *Fig.* 1 and 2, different varieties of WRANGELIA *penicillata*, the *natural* size. *Fig.* 3, one of the smaller branches, with its whorled ramuli ; *fig.* 4, a small portion of the stem or of a large branch ; *fig.* 5, cross section of the same; *fig.* 6, a fertile branch, with terminal involucre and nucleus ; *fig.* 7. nucleus (not quite correctly drawn) ; *fig.* 8, *spores* from the same; *fig.* 9, vertical view of a whorl of ramuli, to shew the excentric position of the branch: the latter figures more or less *magnified.*

2. WRANGELIA *plebeia*, J. Ag. ; " fronds corticate, sub-pinnately branched, and verticillately ramellose at the nodes, penicillate at the apex ; ramelli repeatedly dichotomous, the terminal cells acute, articulations of the ramelli contracted at the dissepiments, 4—5 times as long as broad." *J. Ag. Sp. Alg. vol.* 2, *p.* 708.

HAB. At Vera Cruz, Mexico, *Liebman.*

Probably, as Professor Agardh suggests, only a variety of the preceding species.

ORDER X. RHODYMENIACEÆ.

Rhodymenieæ, J. Ag. Sp. Gen. and Ord. Algarum, p. 373. *Part of Rhodymeniaceæ, Harv. Man. Ed.* 2, *p.* 120. *Part of Sphærococcoideæ and Delesseriaceæ, Auct. &c.*

DIAGNOSIS Purplish or blood-red sea-weeds, with an inarticulate, (flat, compressed or filiform) membranaceous frond, composed chiefly of polygonal cells ; the surface cells forming a continuous coating. *Nucleus* lodged in an external *conceptacle*, simple or formed of several nucleoli. *Spores* at first associated in moni-

liform, branching strings issuing from a placenta, at length massed together without order.

Natural Character. *Root* mostly a mere disc, sometimes, as in *Plocamium*, branching. *Frond* membranaceous in substance, very variable in general habit and branching. Most commonly the membrane is flat, narrow, or expanding into broad dichotomously or irregularly cleft expansions, without trace of midrib or veins. In one genus only (*Wormskioldia*) nerved leaves, of definite form and delicately membranous areolated substance, occur. In *Plocamium* the frond is linear, often very narrow, much branched in a pinnate order, flat or compressed, with or without midrib. In *Rhabdonia* it is terete, the exterior strata composed of the ordinary polygonal cells, the axis of closely interwoven cylindrical cells disposed in filaments.

The sporiferous *nuclei* are always lodged in proper conceptacles, external or partly immersed, usually hemispherical and destitute of apical pore, sometimes opening at the apex, or even furnished with a prominent orifice. These conceptacles are either marginal or scattered over the surface, or (rarely) formed in proper leaf-like processes. Within a densely cellular pericarp, a basal or central placenta is often largely developed ; from it issue toward all sides dense tufts of branching spore-threads, either united in a single nucleus or divided into several, which are sometimes separated by barren filaments running from the placenta to the pericarp. The sporiferous threads are moniliform, branched, articulated, each articulation containing at an early stage a simple mass of endochrome, but by repeated cell-division the contents of each cell is finally converted into a cluster of *spores*, held together by the dilated cell-wall. The clusters thus originated, being confined within the narrow cavity of the conceptacle, are closely pressed together and at length massed into nuclei or nucleoli without obvious order. The spores, also by reason of pressure, become irregularly angular or wedge-shaped. The *tetraspores* are roundish or oblong, and variously parted ; and are either dispersed among the surface cells, or collected in definite sori, or lodged in proper leaflets.

This order has recently been proposed by Professor J. G. Agardh to include a few genera which, on account of the very different structure of their conceptacular fruit, he has rejected from the *Sphærococcoideæ ;* a measure rendered necessary by the new principles of arrangement developed by that author. These plants, however, so closely resemble the genuine *Sphærococcoideæ* in external habit, and even in the internal structure of the stem and leaves, that recourse must sometimes be had to an accurate microscopic analysis of the contents of the conceptacle, before the student can ascertain the proper place in the system of the plant under examination. This is notably the case in the genera *Wormskioldia* (founded on *Delesseria sanguinea*, Ag.) and *Delesseria* (*D. sinuosa*, *&c.*), two genera with fronds of precisely similar texture and appearance, but with a fructification of a structure so different that we are compelled to place them not only in different Orders, but in different Series. If this seems an unnatural distribution, as it certainly is contrary to long established prejudice, let it be remembered that there are species of *Cactus*, *Stapelia*, *and Euphorbia* equally resembling each other in habit,

but equally differing in fructification; and that in every natural arrangement characters derived from the structure of the fructification are to be preferred to all others.

All the genera of this Order are widely dispersed. *Rhodymenia* has species in the Arctic and Antarctic Oceans, as well as in the temperate and tropical zones. *Euthora* and *Rhodophyllis* characterise high northern and high southern latitudes. One species of *Plocamium* is cosmopolitan, while the rest, fourteen in number, are confined to the southern hemisphere. *Rhabdonia*, the only remaining genus, has tropical and Australian species.

Among the useful plants the most remarkable is *Rhodymenia palmata*, the Dulse or Dillisk of the Irish (*see* Introd. *Part* 1, *p.* 33); and among the most beautiful are *Euthora cristata*, *Wormskioldia sanguinea*, and the various species of *Plocamium*,—all highly prized by collectors of "Ocean flowers."

SYNOPSIS OF THE NORTH AMERICAN GENERA.

* *Frond flat, dichotomous or irregularly laciniate or multifid.*

† *Sporiferous nucleus simple, surrounded by a gelatinous integument.*

I. Rhodymenia. *Frond* stipitate, leaf-like, dichotomous or palmate.

†† *Sporiferous nucleus compound, formed of several nucleoli more or less confluent.*

II. Euthora. *Frond* dichotomo-pinnate or laciniate, often very narrow. *Tetraspores* cruciate.

III. Rhodophyllis. *Frond* dichotomous, often fringed with marginal lobes. *Tetraspores* zonate.

** *Frond linear, plano-compressed, pectinato-pinnate, the ramuli alternately secund in threes or fours.*

IV. Plocamium. *Tetraspores* zonate, contained in marginal spore-leaves.

*** *Frond terete, alternately decompound.*

V. Rhabdonia. *Conceptacles* half immersed in the branches. *Tetraspores* zonate, dispersed through the superficial cells.

VI. Cordylecladia. *Conceptacles* external, sessile. *Tetraspores* cruciate, lodged in proper, pod-like ramuli.

I. RHODYMENIA. *Grev.*

Frond flat, membranaceous, dichotomous or palmate, often proliferous from the margin or disc, composed of two strata of cells; the inner cells oblong, the superficial minute, in few vertical rows. *Conceptacles* scattered over the frond, sessile, hemispherical, with a cellular pericarp at length opening by a terminal pore; *sporiferous filaments* very numerous, emitted from a *basal* placenta, and forming a simple nucleus surrounded by a gelatinous pellicle. *Tetraspores* either collected in cloud-like patches, or dispersed over the frond among the superficial cellules, roundish, cruciate or tripartite.

This genus, as originally constituted, included a large number of plants which had a resemblance in habit to each other, but which a more accurate examination has shown to belong to several widely separated types of structure: hence the genera *Euthora*, *Rhodophyllis*, *Kallymenia*, *Callophyllis*, *Calliblepharis*, *Sarcodia*, *&c.*, have been formed at its expence. The generic character, as here given, is that fixed by Prof. J. G. Agardh. It reduces the species now placed in *Rhodymenia* to about a dozen at the most; and, small as this number is, they naturally divide into two sections or sub-genera, distinguished not less by peculiarities of fructification than by minor external characters. In the first section the tetraspores are scattered through the surface cellules over the whole frond; the fronds are of large size, purplish or dull-red, sub-simple or irregularly palmatifid, and the stem is but little developed. In the second the tetraspores are confined to definite sori, placed immediately below the ends of the lobes; the fronds are dichotomous, of a bright red or rosy, and the stem is always considerable, and sometimes branched. The species of this latter section have a habit very similar to that of *Phyllophora*.

1. *Palmatæ*: *tetraspores scattered in cloudy patches over the whole frond.*

1. Rhodymenia *pertusa*, J. Ag.; stipes short, cartilaginous, compressed, expanding into a broadly lanceolate, sub-undivided, membranaceous, blood-red lamina (one to three feet in length) attenuated at the base; conceptacles very numerous, densely scattered over the surface of the frond. *J. Ag. Sp. Alg.* 2, *p.* 376. *Rhodymenia Wilkesii*, *Bail. and Harv. in Bot. Expl. Ex. cum Icone, ined.* *Porphyra pertusa*, *Post. and Rup. Alg. Ross. p.* 20, *t.* 36.

Hab. Straits of St. Juan de Fuca, *Capt. Wilkes.* (v. s.) Greenland, *Wormskiold.*

Root scutate. *Fronds* tufted, rising with a compressed stem, which, at half an inch to an inch from the base becomes flattened, cuneate, and gradually widens, until it passes into the base of a broadly lanceolate lamina, from one to three feet long, and from four to eight or ten inches wide. *Lamina* much attenuated at the base, commonly quite simple, sometimes forked ; the newer portions formed, as in *Laminaria*, between the apex of the cartilaginous stem and the base of the expansion. *Colour* pale blood-red, fading into greenish. *Conceptacles* as large as poppy-seed, spherical, extremely numerous, half immersed in the lamina and scattered thickly through three-fourths of it, commencing at the apex and extending toward the base.

This fine species was originally published under the erroneous generic name of *Porphyra ;* and as such it escaped the notice of Prof. Bailey and myself when, in examining the Algæ of Wilkes' Exploring Expedition, we proposed to give Capt. Wilkes's name to what we rightly considered a *Rhodymenia*, and believed to be an unpublished species. Meantime, Professor Agardh having received specimens of the so-called *Porphyra pertusa*, and at once perceiving that they were referable to *Rhodymenia*, has sanctioned the specific name *pertusa* in his recently published Species Algarum. I am therefore constrained to adopt this name, in preference to that which my friend Bailey and I had proposed. It is given by its author in allusion to certain roundish holes often to be found in the membranes, but which appear to me to be casualties, such as occur in very many of the membranous Algæ, as in *Ulva latissima*, &c. I have received from Dr. Ruprecht an authentic specimen of his plant, and find it identical in species with the specimens brought home by Wilkes. These latter are, however, of much greater size and in more perfect condition.

2. Rhodymenia *palmata*, Grev. ; frond coriaceous or membranaceous, purple, broadly wedge-shaped, irregularly cleft, palmate or dichotomous, sometimes repeatedly laciniate ; the margin flat and even, sometimes winged with leaflets ; tetraspores distributed over the whole frond in cloud-like spots. *Harv. Phyc. Brit. t.* 217 *and* 218. *J. Ag. Sp. Alg.* 2, *p.* 376. *Sphærococcus palmatus, Kütz. Sp. Alg. p.* 781. *Fucus palmatus. Lin.—Turn. Hist. Fuc. t.* 115. *E. Bot. t.* 1306. *Dulse or Dillisk, vulg.*

Hab. Parasitical on littoral *Fuci*, *Laminariæ*, etc. Halifax, *W. H. H.* Boston Bay, *Dr. Asa Gray*, *Mr. G. B. Emerson*, etc. Long Island Sound, *Prof. Bailey*, *Mr. Hooper*, etc. Common. (v. v.)

Frond 6—12 inches long or more, from one to four or six inches broad, cuneate at the base, and generally broadly cuneate in outline, vertically cleft in a sub-palmate manner ; sometimes quite simple, sometimes cloven nearly to the base into innumerable slender ribbons. The margin is generally flat, but is often furnished at intervals with simple or forked leaf-like lobes, giving a pinnate character to the frond. *Apices* obtuse. *Axils* generally acute. *Substance* firmly membranous or

leathery, not adhering to paper except after a long maceration in fresh water. *Colour* a deep brownish purple.

In some specimens dredged in Halifax Harbour the frond is very much broader than its length, but little divided, and having the margin very much waved. The substance is thinner than in the common form, which occurs abundantly at Halifax.

3. RHODYMENIA? *interrupta*, Grev. ; frond membranaceous, irregularly divided, sub-dichotomous ; the laciniæ divaricated, linear, constricted at short intervals ; the terminal lobes digitate ; axils and apices rounded. *Grev. in Nov. Act. Nat. Cur.* xiv. *p.* 423, *t.* xxvi. *fig.* 1. *J. Ag. Sp. Alg.* 2, *p.* 382.

HAB. Arctic Sea, *Lieut. W. N. Griffiths.* (v. s. in Herb. Cl. Dnæ. Griffiths.)

Base unknown. *Frond* (broken) eight or ten inches long, irregularly dichotomous, the terminal lobes digitate or pedate. *Laciniæ* widely spreading or divaricate, about half an inch wide, linear, repeatedly but irregularly constricted at short intervals in a nodose manner ; the margin undulate. *Axils* very obtuse, rounded, from half an inch to an inch wide. *Apices* rounded, somewhat wider than the laciniæ. *Nemathecia* wart-like, small, clustered, growing from the margin or the disc of the lower segments. *Substance* thin. *Colour* a dull red, rather brownish below. It does not adhere to paper.

A thin slice shows two or three rows of large, polygonal, empty medullary cells, with a thin exterior coating of coloured, minute cells, gradually smaller towards the circumference. This structure is different from that of *Phyllophora Brodiæi;* to an extravagant form of which variable plant this curious species bears some resemblance. I have to express my thanks to Mrs. Griffiths for allowing me to examine the single specimen brought home by her son from the Arctic regions, being that from which Dr. Greville's figure was made, and the only one known to exist at present in any Herbarium.

2. *Palmettæ: tetraspores aggregated in distinct sori below the tips of the laciniæ.*

4. RHODYMENIA *Palmetta*, Grev. ; stipes cylindrical, sub-simple, expanding into a fan-shaped, rose-red frond, more or less deeply cleft dichotomously ; laciniæ linear-wedge-shaped, with broad rounded interstices and a very entire, flat margin ; apices either erose or rounded ; conceptacles marginal or scattered ; tetraspores cruciate, forming deep-red sori in the dilated apices. *Harv. Phyc. Brit. t.* 134. *J. Ag. Sp. Alg.* 2, *p.* 378. *Sphærococcus Palmetta, Kütz. Sp. Alg. p.* 782. *Fucus Palmetta, Esper. t.* 40. *Turn. Hist. t.* 73. *E. Bot. t.* 1120.

HAB. On shells and stones in deep water and on the stems of Laminariæ. Halifax. *W. H. H.* (v. v.)

As yet my only authority for claiming American Citizenship for this plant, is a single fragment picked up at Halifax. It is about an inch and half high, and three-forked at half an inch from the base, the lobes linear, cuneate, dichotomous, spreading ; the outline fan-shaped ; the ultimate lobes slender. One or two imperfectly developed conceptacles are sessile on the ultimate laciniæ, about the middle. It is to be hoped that some more fortunate collector may obtain satisfactory specimens.

II. EUTHORA. *J. Ag.*

Frond membranaceous, flat, dichotomo-pinnate, composed of two strata of cells ; those of the inner stratum, oblong, large ; of the outer, coloured, minute, in few rows. *Conceptacles* marginal, sub-spherical, with a closed cellular pericarp (composed of concentrical layers of cellules at one point radiating) ; *sporiferous filaments* very numerous, radiating from a *central* placenta, which is suspended in the cavity of the pericarp by sub-simple filaments ; the fertile spore-threads forming roundish masses of *spores* from their upper cells. *Tetraspores* cruciate, lodged in the thickened apices of the frond.

Separated from *Rhodymenia*, where it had been placed by Greville, by Professor Agardh, on account of the different structure of the conceptacles, a character no doubt of grave importance, although difficult to be seen without a careful dissection ; and this is difficult to accomplish, owing to the minuteness of the object to be cut through. In *Rhodymenia* the placenta projects from the *base* of the cell, and throws up from its upper surface masses of spore-threads, which finally unite into a single globose nucleus ; in *Euthora* the placenta is in the *centre* of the cavity, where it is suspended by cord-like filaments drawn from it to the surrounding walls, and the spore-threads issue from it on every side. This is the essential distinction. Another character is noticed by Prof. Agardh in the structure of the walls of the pericarp, which in *Euthora* are composed of several sub-concentric layers of cells, except at one spot, where the cells are set in lines radiating, like the spokes of a wheel, from the nucleus outwards, and indicating probably, as Prof. Agardh suggests, the point where the wall first gives way to permit the escape of the spores.

1. Euthora *cristata*, J. Ag. ; frond fan-shaped, membranaceous, sub-dichotomous or somewhat pinnately-multifid, the segments dilated upwards and repeatedly subdivided ; lesser divisions alternate, linear, laciniate at the ends, and often fimbriate

at the margin ; conceptacles spherical, marginal ; tetraspores contained in the thickened tips of the laciniæ. *J. Ag. Sp. Alg.* 2, *p.* 385. *Rhodymenia cristata, Grev.—Harv. Phyc. Brit. t.* 307. *Callophyllis cristata, Kütz. Sp. Alg. p.* 747. *Fucus cristatus, L.—Turn. Hist. t.* 23.

Hab. Arctic coast, *Lieut. W. N. Griffiths, R. N.* Abundant from Halifax (*W. H. H.*) to Cape Cod, many varieties, *Mrs. Asa Gray, Mrs. Mudge, Dr. Durkee,* &c. (v. v.)

Frond one to three inches high, distichous, excessively branched, more or less fastigiate, flabelliform, the expansion of the branches equal to the length of the frond. *Branches* linear, varying in breadth from the diameter of a hog's bristle to one or two lines or more, sub-dichotomously, palmately, or alternately decompound, the divisions successively narrowed. Sometimes the whole frond is sub-dichotomous and nearly equally narrow ; sometimes decompound-pinnate, and sometimes a few broad, pinnatifid laciniæ are bordered by finely-cut ramuli. The frond is not perfectly flat, when narrow, but two edged, slightly convex in the centre. *Conceptacles* abundant, spherical, marginal, as large as poppy seed, dark coloured. *Tetraspores* cruciate, thickly congregated in the thickened and dark coloured tips of the laciniæ. *Colour* a beautiful crimson lake, becoming scarlet on steeping in fresh water. *Substance* somewhat cartilaginous. It shrinks in drying, and but imperfectly adheres to paper.

Most of my Halifax specimens are of the narrow varieties, some so narrow and multifid as closely to resemble the smaller and slenderer forms of *Plocamium coccineum.* In Boston Bay, where the plant occurs in great profusion and beauty, broad and narrow varieties are nearly equally common. The geographic range of this species is alluded to in our Introd. p. 23.

III. RHODOPHYLLIS. *Kütz.*

Frond flat, membranaceous, dichotomously cleft, often with marginal lobes, composed of two strata of cells: cells polygonal, those of the medullary stratum larger, longitudinal ; of the outer, vertical, in few rows. *Conceptacles* mostly marginal, sub-spherical, with a closed pericarp (composed externally of radiating, internally of concentrically arranged cellules) ; sporiferous filaments very numerous, radiating from a basal placenta ; the fertile ones forming roundish masses of spores from the uppermost cells. *Tetraspores* zonate, immersed in the frond or in its marginal lobes.

A small genus typified by *Rhodymenia bifida*, Grev. (*Fucus bifidus*, Turn.), and

now including four species, three of which are natives of the northern and one of the southern hemisphere. It differs from the restricted genus *Rhodymenia* partly by the structure of the nucleus, and partly by the zonate tetraspores. The generic name here adopted was proposed in 1847 by Kützing, who probably overlooked the name *Wigghia* which I suggested (*Phyc. Brit. t.* 32) some few months earlier. Hoping to find some future opportunity of honouring the memory of Mr. Lilly Wigg, I cheerfully acquiesce in the change.

1. Rhodophyllis *Veprecula*, J. Ag.; "frond dichotomo-decompound, and pinnated at the margin; pinnæ lanceolate or linear, ciliate; cilia subulate, short or the longer ones forked; conceptacles densely clustered at the base of the cilia, often confluent; tetraspores numerous, lodged in the cilia." *J. Ag. Sp. Alg.* 2, *p.* 390. (*excl. Syn. Beechey.*)

Hab. Greenland, *Agardh.*

"Two to three inches high; the segments sometimes scarcely a line, sometimes three or four lines broad, ciliate, the cilia either very short and subulate, or half an inch long and once or twice forked. *Conceptacles* clustered around the base of the shorter cilia. *Colour* rose-red or brownish. It scarcely adheres to paper."

This plant I have not seen. Prof. J. Agardh seems to doubt whether it may not more properly be referred to *Calliblepharis*. His quotation of "Rhod. ciliata β. microphylla, Bot. Beech. Voy. p. 164," is incorrect.

IV. PLOCAMIUM. *Lamour.* (reform.)

Frond sub-cartilagineo-membranaceous, linear, plano-compressed, pinnately decompound (the pinnules alternately secund in pairs, or in threes and fours): composed of two strata of cellules; the inner cellules longitudinal, oblong, the outer polygonal, coloured, small. *Conceptacles* sessile or pedicellate, hemispherical, with a cellular pericarp finally opening by a pore; *sporiferous filaments* very numerous, radiating in several tufts (some generally barren) from a basal placenta; the fertile forming masses of spores from their upper cells. *Tetraspores* lodged in proper spore-leaves (*stichidia*), oblong, zonate.

A beautiful genus, readily distinguished by the very peculiar ramification. The frond in all is linear, distichously branched, two-edged or flat, sometimes membranaceous and furnished with a midrib, sometimes thickened and cartilaginous, pin-

nately decompound. The pinnules are of two kinds; the *primary* or lowest in position are generally simple, short, acute, either subulate or cultrate, and are set distichously at alternate sides of the branch; the *secondary* are pinnulate or pectinato-decompound, and spring singly, or two, three, or four consecutively from above the axil of their primary, in the space between its place and that of the next primary at the opposite side of the stem. In this way, the ramuli throughout the frond are alternately geminate, ternate, quaternate, etc. In one section of the genus, peculiar to the southern hemisphere, the ramuli are geminate; that is, each primary subtends but one secondary ramulus; in the other section, to which our *P. coccineum* belongs, two or more secondaries are ranged above each primary. All the species are remarkable for their brilliant colour.

1. Plocamium *coccineum*, Lyngb.; frond narrow, cartilaginous, plano-compressed, decompound; ramuli alternately ternate or quaternate, the lowest of each series subulate, very entire, the upper pectinate on their upper edges; conceptacles marginal, solitary, sessile; spore-leaves on the inner faces of the pectinate ramuli, divaricately branched. *Harv. Phyc. Brit. t.* 44. *J. Ag. Sp. Alg.* 2, *p.* 395. *Kütz. Sp. Alg. p.* 883. *Fucus coccineus*, *Huds. Turn. Hist. t.* 59. *E. Bot. t.* 1242.

Hab. San Francisco, California, *Dr. Sinclair*, *Capt. Pike*. Boston Bay, *Miss Hawkshurst*. (v. v.)

Captain Pike's specimen is about four inches high, a line broad, alternately and distantly branched, the stem and branches two-edged, but not much compressed below, flatter above. *Branches* decompound in their upper half. *Ramuli* generally alternately ternate or quaternate, the lowest ramulus subulate, about a line long, the two above it elongate, compound in a similar order. *Stichidia* formed from the ultimate ramuli of the upper divisions of the branches, palmate or dichotomous, the divisions truncate. *Colour* a dark lake-red. *Substance* cartilaginous. It imperfectly adheres to paper.

The rarity of *Plocamium coccineum* on the eastern shores of North America is very remarkable, considering that it is common on the Atlantic shores of Europe, and throughout a very wide extent of the Southern Ocean. The Californian specimen above described is more robust, more cartilaginous, and less compressed than any that I possess from other quarters, but offers no peculiarity of ramification by which it can be distinguished.

V. RHABDONIA. *Harv.*

Frond terete, decompound, somewhat tubular; tube partially filled with longitudinal, branching and anastomosing filaments; the peripheric stratum composed of

polygonal cellules, smaller toward the surface. *Conceptacles* immersed in the branches beneath the peripheric stratum, but prominent to one side, the walls formed of a dense plexus of filaments derived from the axis ; *placenta* fibro-cellular, central, suspended in the cavity by slender filaments connected with the walls ; *spore-threads* emitted in tufts from all sides of the central placenta, moniliform, forming strings of *spores* in their articulations. *Tetraspores* dispersed through the superficial stratum of the frond, oblong, zonate.

I have already remarked under *Solieria* the very close resemblance, in external habit and in the structure of the frond, between the species of that genus and of the present one. Indeed, except in the development of the spores,—a character, however, which obliges us to refer them to widely distant Orders—the two genera are undistinguishable. *Rhabdonia* was founded on two Australian Algæ, very similar in aspect to the plant now to be described ; and Prof. Agardh has added four others, one of which is a native of the West Indies, and may possibly occur at Key West.

1. Rhabdonia *Coulteri*, Harv.; frond filiform, setaceous and bare of branches below, gradually incrassated upwards, pinnate or sub-bi-pinnate above ; pinnæ and pinnulæ patent, lineari-fusiform, attenuate at the base, obtuse or sub-acute ; conceptacles plentiful, half immersed, hemispherical ; tetraspores of large size, dispersed. (Tab. XXIII. B.) *Hypnea Coulteri, Harv. in Bot. Expl. Exp. ined.*

Hab. Monterey, California, *Dr. Coulter.* North West Coast, *Capt. Wilkes.* (v. s. in Herb. T.C.D.)

Root a large disc, throwing off creeping fibres. *Fronds* densely tufted, 6—8 inches high, not thicker than hog's bristle below, gradually thickened upwards to the diameter of a crow's quill. *Stem* once or sometimes twice forked within an inch or two of the base, afterwards simple, naked for half its length, closely pinnate or occasionally bipinnate in its upper half, the pinnæ a line or two apart, very patent, 2—3 inches long, the barren ones as thick as sparrow's quill, the fertile ones twice or thrice that thickness. The pinnules when present are in all respects similar, but are very irregularly placed, often secund. *Conceptacles* large, plentifully lodged in the lesser branches, prominent to one side, as if hemispherical or sub-conical. *Tetraspores* dispersed in the branches. *Colour* a very dark, brownish red. *Substance* cartilaginous. It shrinks and scarcely adheres to paper in drying.

Barren plants are setaceous, irregularly divided, and scarcely dilated upwards.

Tab. XXIII. B. *Fig.* 1. Rhabdonia *Coulteri ;* the *natural* size. *Fig.* 2, longitudinal section of a branch, showing *tetraspores* lodged in the surface cells ; *fig.* 3, small portion of the periphery of the same, with two tetraspores ; *fig.* 4, transverse section of a branch, cutting horizontally through a conceptacle ; *fig.* 5, portion of

the same, showing part of the peripheric stratum, of the fibro-cellular wall and placenta, and of the tufts of spore-threads issuing from the latter; more or less *magnified*.

VI. CORDYLECLADIA. *J. Ag.*

Frond filiform, irregularly branched, carnoso-cartilaginous, formed of two strata of cells; medullary layer of oblong, longitudinal cells, cortical of roundish, coloured, sub-seriated, vertical minute cellules. *Conceptacles* sessile on the branches, sub-spherical, furnished with a cellular pericarp at length perforate, containing a densely packed globular mass of roundish-angular spores, formed by the evolution of much-branched filaments issuing from a basal placenta. *Tetraspores* immersed in the periphery of pod-like ramuli, oblong, cruciately parted.

The type of this genus is *Gracilaria erecta*, Grev. (*Harv. Phyc. Brit. t.* 177.); a little plant, known only on the shores of the British Islands. In the above quoted figure, which in other respects is characteristic, the tetraspores are incorrectly represented as being *zonate*, instead of *cruciate*, as I find them to be on a renewed examination. The two following species are only doubtfully referred to this genus, their fruit being as yet unknown.

1. Cordylecladia ? *Huntii;* fronds densely tufted, springing from a common, expanded, crust-like disc, livid purple, tereti-compressed, once or twice forked or secundly branched; branches subulate, attenuate, acute; fruit . . . . ?

Hab. Narragansett Bay, *Mr. Geo. Hunt.* (v. s. in Herb. T.C.D.)

Common crustaceous base, an inch or more in diameter. *Fronds* densely tufted, 2—3 inches high, setaceous below, twice as thick as hog's bristle above, evidently compressed, especially in the upper portion, erect, sub-simple, irregularly divided; sometimes once or twice forked, sometimes with one or two secund lateral branches, sometimes both forked and secundly branched. *Branches* filiform, attenuated, acute. *Fruit* unknown. *Colour* a livid purplish, fading into white. *Substance* cartilaginous, rather soft, adhering to paper in drying. Medullary stratum composed of polygonal cells, filled with granules and smaller towards the margin; cortical of minute, coloured sub-seriated cells.

In the absence of fruit this must remain doubtful. I have as yet seen but a single specimen, which I place in this genus from its strong outward resemblance

to *C. erecta*, from which it differs in being evidently compressed, and in the dull purple colour.

2. Cordylecladia ? *irregularis ;* frond filiform, more or less hollow, setaceous, rigid, densely tufted, irregularly branched, somewhat pinnate ; branches few, opposite or secund, widely spreading, simple, obtuse.

Hab. Key West, *Prof. Tuomey*, (5) *Dr. Blodgett*, (45) *W. H. H.* (55) (v. v.)

Frond in densely matted tufts, rising from fibres ? two to three inches high, as thick as hog's bristle, rigid, mostly hollow in the centre, very irregularly branched. Some specimens are pretty regularly pinnate, or sub-bi-pinnate, the pinnæ mostly opposite ; others (and these are more common) are set with numerous, lateral, secund branches, which occasionally bear a second series of secund branchlets ; and some fronds have both kinds of branching in different parts. All the branches are patent, of unequal lengths. *Colour* a dark reddish brown, turning green in fresh water, or in decay. A cross-section shows a single row of oblong, coloured, peripheric cells, within which are several rows of irregularly polygonal partially coloured cells, gradually of larger size towards the centre of the axis, where there is an irregular cavity (or deficiency of cells) of greater or less diameter. *Substance* rigid. No fructification seen ; but some of the tips of the branches are slightly expanded, as if designed to contain tetraspores. In drying it scarcely adheres to paper.

I am very doubtful of the generic relation of this plant, but can think of no more convenient place to put it, the fruit being unknown, than in this genus.

Order XI. CRYPTONEMIACEÆ.

Cryptonemeæ and Gigartineæ, with part of Dumontieæ, J. Ag. Sp. Gen. and Ord. Algarum, pp. 165, 229, 346. *Cryptonemeæ (excl. gen.) J. Ag. Alg. Medit. p.* 66. *Endl. 3d. Suppl. p.* 36. *Harv. Man. Ed.* 2, *p.* 131, *&c.*

Diagnosis. Purplish or rose-red sea-weeds, with an inarticulate (cartilaginous, horny, coriaceous, or gelatinous, rarely membranaceous) frond, composed wholly or in great part of articulated confervoid filaments, compacted together by gelatine ; the membranous species sometimes composed of polygonal cells gradually smaller toward the surface. *Nucleus* either sunk in the frond or lodged in an external

conceptacle, simple, or formed of several associated nucleoli. *Spores* congregated without order in the fertile cells or nucleoli.

Natural Character. *Root* seldom more than a mere disc, rarely accompanied by creeping fibres, or forming a prostrate mat from which numerous stems arise. *Frond* extremely various in size and in outward form, sometimes scarcely an inch in height, sometimes (in the *Iridææ*) two or more feet in length and breadth. Sometimes it is filiform, and then frequently dichotomous, more rarely pinnately parted; sometimes a stipes, soon compressed above the base, gradually widens upwards into an expanded, simple or dichotomous lamina, which is occasionally obsoletely midribbed below. Some laminæ are in such cases proliferous, new frondlets springing either from the surface or apices of the old. Sometimes the frond forms a cylindrical, or moniliformly-constricted, undivided or branching tube, the hollow either filled with air or with loose watery gelatine through which a few filaments are dispersed; and sometimes it is completely bag-like, much inflated, ovate or sub-globose.

The *substance* of the frond is as various as the form. It is frequently cartilaginous, gelatino-cartilaginous, or fleshy, sometimes quite gelatinous; rarely coriaceous, and still more rarely membranaceous; in this last case the membrane has much the substance of parchment. It is usually opaque, sometimes semi-transparent, never exhibiting proper articulations to the eye; but when dissected and thin slices are examined under the microscope, the whole substance of a large majority of the plants of this Order, or a greater or less portion of the frond in the remaining species, is seen to be composed of innumerable, slender, confervoid *filaments*, lying in a transparent gelatine, and variously combined together. These filaments are sometimes cylindrical with long articulations, sometimes moniliform, like strings of roundish or oblong beads, and both forms often occur in the same frond. Cylindrical filaments are more commonly found in the middle or medullary portion, and are then always longitudinal in direction, running parallel with the longitudinal axis of the stem or branch. Moniliform filaments are very common in the periphery or external stratum, where they lie at right angles with the longitudinal axis, or vertical to the surface of the frond. Sometimes these radiating peripheric filaments issue directly, as lateral branches, from the longitudinal ones of the axis; sometimes a net-work of anastomosing filaments, or a stratum composed of large, roundish cells, imperfectly ordinated in rows, intervenes: and in a few cases, (as in *Callophyllis*) the medullary region is composed of large, roundish cells, each cell encompassed by a net-work of very delicate filaments. Such genera conduct us to others in which the frond becomes less and less perfectly composed of filaments; roundish and polygonal cells being more and more introduced into its construction. Thus, in the tribe *Tylocarpeæ*, the whole central portion of the frond is made up of polygonal or honey-combed cells, the periphery alone exhibiting a filamentous character, and even this often in a very imperfect

degree. These latter genera lead us at once in structure to the RHODYMENIACEÆ, from which they can be known only by the structure of the nucleus.

The *sporiferous nucleus* is very frequently sunk in the frond, beneath the filaments of the periphery; where it either lies suspended among those of the inner stratum, or it is encompassed by a dense plexus of filaments, forming a sort of immersed conceptacle, not unlike the *coccoon* of a chrysalis. In a few cases (as in *Chrysymenia*, *Chylocladia*, *Gigartina*, etc.) it is lodged in an external globose or hemispherical *conceptacle*, with or without a terminal pore; and in *Stenogramma* many compound nuclei lie within a linear, rib-like conceptacle, running through the middle of the leaf.

The Order naturally divides itself into two sub-orders, distinguished from each other by the greater or less complication of the nucleus. These have been recently elevated by Prof. Agardh into the rank of Orders, but as it appears to me rather unnecessarily; the difference in nucleatic structure being one of degree only, and the plants of both sub-orders having a most intimate relationship in structure and habit. In our first sub-order (GIGARTINEÆ) the *nucleus* originates in *several* congregated, fertile cells, filled at first with dense granular matter or *endochrome*. These, as the fruit matures, enlarge, while the matter contained in each divides into numerous spores; and each original cell is thus converted into a *nucleolus* of spores, retained within the expanded cell-wall; which then forms (till it disappears) a membranous *periderm* to the nucleolus. The whole *nucleus*, or aggregation of these *nucleoli*, appears at first divided by pellucid lines, marking the boundaries of the mother-cells; but all traces of these generally disappear before the spores are emitted, and at this advanced stage it is not always easy to recognise the proper structure. In our second sub-order (CRYPTONEMEÆ) the *nucleus* originates in a *single* cell, which undergoes similar changes to those just described as occurring in the numerous mother-cells of the first sub-order.

The *tetraspores* are either dispersed among the cellules of the periphery, or collected into definite, superficial, or immersed sori; and in a few cases are formed in external wart-like bodies of irregular shape, called *nemathecia*. They are sometimes zonate, but more commonly cruciate.

This is one of the largest Orders of Rhodosperms, and is dispersed through all latitudes from the Arctic regions to the Equator. Thirty-five genera are described by Agardh, twenty-three of which we already claim for the North American Flora; and probably when our coasts have been more fully examined, several others may be added.

Among the useful plants of the Order is *Chondrus crispus* or Carrageen, so well known as an ingredient in blanc-manges and jellies; and many others, particularly of the genera *Iridæa* and *Gigartina*, numerous large species of which are common on the Pacific coasts, have similar properties.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

Sub-order 1. GIGARTINEÆ. *Nucleus* compound ; consisting of several congregated *nucleoli*, or roundish masses of spores.

Tribe 1. Tylocarpeæ : *Frond* rigid, compact ; its inner stratum composed of roundish, polygonal cells; its outer of closely packed, vertical, minute filaments. *Tetraspores* contained in external, raised sori or warts.

* *Frond leaf-like, flat. Conceptacles external.*

I. Stenogramma. *Frond* dichotomous, membranaceous, rose-red. *Conceptacles* linear, rib-like, medial on the lobes of the frond.

II. Phyllophora. *Frond* stipitate, flabelliform, cleft. *Conceptacles* roundish, scattered.

** *Frond linear, compressed or filiform. Conceptacles immersed.*

III. Gymnogongrus. *Frond* sub-terete, compressed or flattish, sub-cartilaginous.

IV. Ahnfeltia. *Frond* terete, horny.

Tribe 2. Kallymenieæ : *Frond* membranaceous or coriaceous, its inner stratum composed either of longitudinal filaments, or of polygonal cells surrounded by a net-work of filaments ; its outer stratum of roundish or polygonal cells, smaller towards the circumference, the cortical cellules disposed in minute vertical filaments.

* *Frond cylindrical, alternately decompound.*

V. Cystoclonium.

** *Frond flat, its inner stratum composed of large, roundish cells, surrounded by a net-work of anastomosing filaments.*

VI. Callophyllis. *Frond* dichotomous, bright red.

*** *Frond flat, its inner stratum composed of longitudinal, interlaced filaments.*

VII. Kallymenia. *Frond* sub-sessile, expanded, indefinite in form.

VIII. Constantinea. *Frond* caulescent, branched; the branches expanding into carnoso-coriaceous definite laminæ.

Tribe 3. Eu-gigartineæ: *Frond* cartilaginous, wholly composed of innumerable, slender, anastomosing, longitudinal and horizontal filaments, set in a firm, pellucid gelatine. *Tetraspores* collected in sori.

* *Nucleus lodged within a pseudo-pericarp, composed of densely interwoven filaments.*

IX. Gigartina. *Frond* terete or flat, mostly branched. *Conceptacles* external, globose.

X. Iridæa. *Frond* flat, simple or vaguely cleft. *Nuclei* immersed in the frond.

** *Nucleus immersed in the frond, without definite border.*

XI. Chondrus. *Frond* dichotomous, flabelliform.

Tribe 4. Endocladieæ: *Frond* cartilaginous, terete, sub-tubular, formed of a solitary, longitudinal, articulated, axial filament, from which short, horizontal, fastigiate filaments issue on all sides, and are united by firm gelatine into a continuous peripheric stratum.

XII. Endocladia. Peripheric filaments whorled.

XIII. Gloiopeltis. Peripheric filaments alternate.

Sub-order 2. CRYPTONEMEÆ. *Nucleus* simple; consisting of a single roundish mass of spores.

Tribe 5. Gastrocarpeæ: *Frond* membranaceous or sub-gelatinous; its inner stratum (sometimes obsolete in the tubular fronds) composed of elongated filaments variously anastomosing; its outer stratum of one or more rows of roundish-polygonal cells, smaller towards the surface, and coalescing into a membranous cortical layer.

* *Frond rigidly membranaceous, flat and leaf-like.*

XIV. Cryptonemia.

** *Frond either filiform or flat, very lax within, or sometimes tubular and inflated.*

† *Conceptacles external with a definite pericarp.*

XV. Chylocladia. *Conceptacles* external, sessile, conico-acuminate, containing a mass of spores surrounded by a gelatinous limbus. *Frond* tubular, linear.

XVI. Chrysymenia. *Conceptacles* half immersed in the frond, obtuse or acute, containing a very dense, depressed-spherical mass of minute spores attached to a basal placenta. *Frond* compressed or inflated, hollow or subsolid.

†† *Sporiferous nuclei immersed in the frond.*

XVII. Halymenia. *Frond* flat or compressed, dichotomous or pinnate.

††† *Nuclei unknown* (station in the Order doubtful.)

XVIII. Halosaccion. *Frond* membranaceous, tubular or inflated; the walls of the tube composed on the inside of roundish polygonal cells; toward the surface of minute, oblong, vertically seriated cellules.

Tribe 6. Nemastomeæ: *Frond* cartilaginous, coriaceous or gelatinous, wholly composed of filaments; the inner stratum longitudinal, interlaced, the outer vertical to the surface and dichotomo-fastigiate.

* *Nuclei lodged in terminal, pod-like branches.*

XIX. Furcellaria. *Frond* terete, dichotomous, fastigiate.

** *Nuclei lodged in terminal, wart-like excrescences.*

XX. Acrotylus. *Frond* terete, simple or forked, cartilaginous.

*** *Nuclei dispersed through the unaltered frond.*

† *Frond compressed or flat, solid, and of very compact substance.*

XXI. Prionitis. A stratum of roundish cells interposed between the medullary and peripheric strata, which are composed of filaments.

XXII. Grateloupia. Destitute of intermediate stratum; medullary stratum of densely interwoven filaments; periphery of vertical, moniliform, closely packed filaments.

†† *Frond tubular, membranous or gelatinous.*

XXIII. Catenella. *Frond* membranous, moniliform; constricted at regular intervals as if jointed. *Nuclei* in minute, contracted ramuli.

XXIV. Gloiosiphonia. *Frond* gelatinous, filiform.

I. STENOGRAMMA. *Harv.*

Frond rose-red, membranaceous, flat, dichotomous and proliferous from the margin, composed of two strata; the inner of several rows of roundish-polygonal empty cells, the outer of minute coloured cellules. *Conceptacles* (resembling a midrib) linear, traversing the medial portion of the fertile lobes; containing, within a thick pericarp composed of radiating cellules, numerous dense clusters of roundish spores, massed together without order; the clusters affixed to all sides of the pericarp. *Nemathecia* superficial, wart-like, scattered, formed of vertical, moniliform filaments, whose articulations are at maturity changed into strings of cruciate tetraspores.

The rare and singular Alga which at present constitutes this very distinct genus was first found at Cadiz in Old Spain by M. Cabrera, and described by the elder Agardh in 1823, under the name *Delesseria interrupta;* the linear conceptacles which are seen on the lobes of fertile specimens having been regarded by the great Swedish Algologist as an interrupted midrib. About ten years subsequently, a solitary specimen, larger and less delicately membranous than the Spanish plant, was brought from California by Capt. Beechey, and described by me in the Botany of Beechey's Voyage as *Stenogramma Californica.* I did not at that time suspect that it had any connexion with the *Del. interrupta* of Agardh, which I only knew by the short description given in the Sp. Alg. vol. 1, p. 179. Some years passed without more being added to the history of this plant. At length, in 1839, Dr. Montagne published a figure in Webb's Otia Hispanica of the *Delesseria interrupta*, continuing the Agardhian name. Afterwards, in 1846, the same author found in Bory's Herbarium a specimen, said to have been gathered on the coast of France, agreeing in character with my *S. Californica;* and then for the first time perceived the relationship which the *Del. interrupta*, Ag. bore to it. He accordingly removed the latter plant to the genus *Stenogramma*, calling it *S. interrupta.* Late in the autumn of the same year, 1846,* Dr. John Cocks discovered *S. interrupta* in Plymouth Sound, on the south coast of England, and afterwards dredged it several times in 5—6 fathoms water, the specimens being attached to small stones. All the specimens hitherto seen either produced the linear *conceptacles*, or were barren. The *tetrasporic* fruit was communicated to me in 1848 by Miss Gifford, who discovered it on the Somersetshire coast; but was first described by Dr. Montagne in 1851 (*An. Nat. Hist. ser.* 2, *vol.* 7, *p.* 481.) from specimens collected in the Tagus, near Lisbon, by Dr. Welwitch. In the summer of 1851, I received from New Zealand numerous specimens with both kinds of fruit; and in the autumn had the pleasure to hail it as a native of Ireland, Mr. Isaac Carroll having dredged specimens with conceptacles and tetraspores in Cork Harbour. I have now had the advantage of examining and comparing together specimens from all the above localities, and the result is a conviction that all belong to one species; though the frond is

* Misprinted 1847 in Phyc. Brit. t. 157.

liable to some small variety in substance and ramification. The New Zealand specimens are much the largest that I have seen; but the lobes in the original Californian fragment being still broader, it is probable that the specimens hereafter to be brought from the latter country will surpass any now in our collections.

1. Stenogramma *interrupta*, Mont. *Harv. Phyc. Brit. t.* 157. *J. Ag. Sp. Alg.* 2, *p.* 391. *Kütz. Sp. Alg. p.* 873. *Delesseria interrupta*, *Ag. Sp. Alg.* 2, *p.* 179. *Mont. in Webb. Ot. Hisp. t.* 8. *Stenogramma Californica*, *Harv. in Bot. Beechey*, *p.* 408. (Tab. XIX. C.)

Hab. San Francisco, California, *Dr. Sinclair*. A fragment picked up at Key West, Florida, *W. H. H.* (41.) (v. v.)

Root discoid. *Frond* stipitate, the stipes compressed upwards and passing into the cuneate base of a flabelliform, dichotomously cleft lamina, 4—8 or 10 inches in length, and as much in expansion. *Laciniæ* linear, obtuse, repeatedly forked; sometimes irregularly dichotomous, sometimes palmately or alternately cleft, and often furnished at the edges with proliferous, oblong or forked leaflets. Barren fronds, as well as those destined to produce *nemathecia*, are quite nerveless. In fertile or conceptacle-bearing fronds, a slender pseudo-nerve runs through the centre of each fertile lobe, commencing just below one of the furcations, and terminating nearly opposite to a lower fork. In this pseudo-nerve the conceptacle is formed, a less or greater portion becoming thickened, dark coloured, hollow within, and developing from its medullary cells very numerous *nucleoli*, which are densely aggregated together into a linear, sausage-like nucleus. The *tetraspores* are evolved from the radiating filaments of blotch-like, dark red *nemathecia*, scattered irregularly on both surfaces of the frond, and originating in a transformation of the cells of the cortical layer. The substance of the frond is membranaceous, rather rigid below, flaccid, and often delicately thin above. The *colour* is a fine clear pinky red. In drying, it scarcely adheres to paper.

Our figure is taken from the original Californian specimen, now preserved in Sir William J. Hooker's Herbarium, and represents the base of the frond and one of the two principal segments into which it divides. This specimen is more rigid in substance and darker in colour than ordinary European specimens, but an extensive suite from New Zealand connect it with the smallest and most delicate varieties. My specimen from Key West is fragmentary and barren, but very like some of the smaller European grown fronds.

Plate XIX. C. Stenogramma *interrupta*; the *natural* size. *Fig.* 2, the apex of a fertile lobe; 3, section through the same (the *nucleus* not correctly analyzed); *fig.* 4, spores; the latter figures *magnified*.

II. PHYLLOPHORA. *Grev.*

Frond stipitate ; the stipes expanding upwards into a rigid-membranaceous, flat, simple or cloven lamina, proliferous from the disc or margin, nerveless or faintly nerved at base, formed of two strata of cells ; the medullary portion of oblong, polygonal, empty cells ; the cortical of minute, coloured, vertically seriated cellules. *Conceptacles* sessile or pedicellate, globose or rugged, closed, containing within a thick pericarp, a *nucleus* composed of several coalescing *nucleoli* or masses of minute spores. *Nemathecia* external, wart-like, scattered, formed of vertical, moniliform filaments, whose articulations are at maturity changed into strings of cruciate tetraspores.

The plants of this genus are generally found attached to rocks, near low water mark, or at a greater depth on exposed coasts. Their root is an expanded disc, from which numerous fronds rise in tufts. The young frond commences by pushing up a filiform stipe, which becomes compressed upwards and passes gradually into the cuneate base of a simple, bifid or dichotomous, somewhat flabelliform lamina. From the margin or disc of this primary frond others similar to it in form but with less developed stipites spring proliferously, and thus the plant continues to grow by successive epiphyllous branches. In some species a faint evanescent midrib may be traced from the apex of the stipes into the lower part of the frond. All are of a rigid substance, scarcely at all adhering to paper in drying. Some are of a fine blood-red colour, others livid purplish. The *nemathecia* or warts containing *tetraspores* afford beautiful microscopic objects.

1. Phyllophora *Brodiæi*, J. Ag. ; stipe cylindrical at base, compressed upwards, branched, the branches expanding into oblong or wedge-shaped, simple or forked, flat, membranaceous laminæ, which are frequently proliferous from the summit ; conceptacles globose, sessile on the laminæ ; nemathecia spherical, pedunculate, at the tips of the laminæ. *J. Ag. Sp. Alg.* 2, *p.* 330. *Harv. Phyc. Brit. t. XX. Coccotylus Brodiæi, Kütz. Sp. Alg. p.* 791. *Fucus Brodiæi, Turn. Hist. t.* 72. *E. Bot. t.* 1966.

Hab. Dredged in 4—10 fathom water. Halifax, *W. H. H.* Maine, *Mr. Hooper.* Boston Bay, *Mrs. Asa Gray.* (v. v.)

Stem filiform, as thick as sparrow's quill, 3—4 inches long, compressed upwards, irregularly branched, each branch ending in a cuneate, simple or forked, flat lamina, very variable in breadth and in the amount of division, and very generally proliferous either from the margin or the disc. A large suite of specimens now before me exhibit many curious forms ; in some, the laminæ are from two to four lines wide, cuneate, obtusely bifid or once or twice forked, with a few apical cuneate

frondlets ; in others, the laminæ are repeatedly forked, and these strongly resemble *Rhodymenia Palmetta*. In others, a narrow, cuneate, twice or thrice-forked lamina has its ultimate laciniæ suddenly widened into cuneato-reniform lobes from one to two inches wide, and either simple, bifid, trifid, or more commonly truncate and eroded at the summit ; these lobes are so much wider than the laciniæ which bear them, that the latter appear like mere stipites in comparison. *Colour* a deep, clear, and full lake red, becoming darker in drying. *Substance* rigid.

I dredged numerous varieties of this plant at Halifax, some of them perfectly resembling the common European form ; others altogether peculiar ; and others approaching so nearly to the Antarctic *Ph. cuneifolia*, Hook. and Harv. (from the Falkland Islands) as to render the specific validity of that plant doubtful.

2. Phyllophora *membranifolia*, J. Ag. ; stem cylindrical, filiform, branched ; the branches expanding into broadly wedge-shaped, bifid or dichotomous laminæ ; conceptacles ovoid, stipitate, rising from the branches or laminæ ; nemathecia forming broad, dark-coloured, convex patches in the centre of the laminæ. *J. Ag. Sp. Alg.* 2, *p.* 334. *Harv. Phyc. Brit t.* 163. *Phyllotylus membranifolius, Kütz. Sp. Alg. p.* 790. *Fucus membranifolius, Turn. Hist. t.* 74. *E. Bot. t.* 1965.

Hab. Boston Bay (in fruit), *Mrs. Asa Gray, W. H. H.* Newport, Rhode Island, *Prof. Bailey and Mr. S. T. Olney.* New York, *Messrs. Hooper and Calverley.* Long-branch, New Jersey, *Miss Morris.* (v. v.)

Stem filiform, three to four inches long, as thick as sparrow's quill, irregularly divided ; branches ending in fan-shaped, repeatedly forked, flat laminæ, one to two inches long. *Laciniæ* cuneiform, widely spreading, with very wide, rounded axils, two to four lines broad, obtuse. *Conceptacles* as large as rape-seed, stipitate, scattered on the branches or laminæ. *Colour* a dull brownish-purple or livid. *Substance* rigidly membranaceous.

III. GYMNOGONGRUS. *Mart.*

Frond carnoso-coriaceous, terete, compressed, or flat, linear, dichotomous, composed of two strata of cells ; the medullary stratum of roundish-angular, empty cells ; the cortical of moniliform, vertical, closely packed, short filaments, formed of minute, coloured cellules. *Conceptacular-nucleus* immersed in the frond, more or less prominent, consisting of several associated *nucleoli* or masses of minute spores. *Nemathecia* external, hemispherical, wart-like, formed of radiating, moniliform filaments, whose articulations are at maturity changed into strings of cruciate tetraspores.

Readily distinguished from the last genus by the narrow, generally sub-terete frond, never expanding into membranous leaves, and by the immersed conceptacular fruit. In external habit the *Gymnogongri* much more nearly resemble species of *Chondrus*, in which genus several were formerly included, but they differ from the true *Chondri* essentially in the structure of their medullary stratum. Nearly twenty species are already known, natives of various parts of the world.

1. Gymnogongrus *Torreyi*, J. Ag. ; "frond compressed, flattish, dichotomous, fastigiate ; the segments linear, very narrow ; the axils rounded." *J. Ag. Sp. Alg.* 2, *p.* 319. *Sphærococcus Torreyi*, *Ag. Sp.* 2, *p.* 254.

Hab. New York, *Prof. Torrey* in Herb. Agardh.

"*Fronds* a span long, regularly dichotomous, nearly terete below ; segments linear, very narrow, scarcely a line broad, gradually attenuated toward the obtuse apices. *Axils* rounded ; all the segments ascending and forked at the summit. *Substance* coriaceo-corneous, rigid. *Colour*, in the dry state, brownish." *Ag.*

I have not seen an authentic specimen of this plant, but have received from *Mr. Hooper* a small fragment, which may possibly belong to it. It was found at Fort Hamilton, and is about an inch high, and half a line in diameter, compressed, flabelliform, fastigiate, dichotomous, the segments divaricating, obtuse, or subtruncate, sometimes emarginate. *Colour* a very dark red-brown. *Substance* cartilagineo-coriaceous. *Structure* as in the genus. This specimen resembles *G. Griffithsiæ*, but is broader and more compressed, and the medullary cells are rather different. It is well worth the attention of the Brooklyn Algologists to endeavour to clear up the history of this little-known species.

2. Gymnogongrus *tenuis*, J. Ag. ; "fronds tufted, flat, membranaceous, dichotomous, sub-fastigiate ; segments linear, the upper ones narrower ; conceptacles scattered, hemispherically prominent towards one surface of the lamina, flat towards the opposite surface." *J. Ag. Sp. Alg.* 2, *p.* 319.

Hab. On the shores of the Mexican Republic, *Liebman*, (v. s. in Herb. T. C. D.)

Densely tufted, about an inch and half high, dichotomously-decompound, the upper segments narrow or multifid. *Axils* sub-acute. *Colour* purplish. *Substance* membranaceous, thin.

Nearly related to *G. Norvegicus* but thinner in substance, of a purplish colour, and with more prominent conceptacles. I am indebted to Senator Binder of Hamburgh for an authentic specimen.

3. Gymnogongrus *Norvegicus*, J. Ag. ; frond linear, dichotomous, flat, fastigiate ;

the axils patent, rounded ; apices obtuse ; conceptacles imbedded in the upper segments, numerous, slightly prominent toward both surfaces ; nemathecia sessile, hemispherical, densely scattered over both surfaces of the frond. *J. Ag. Sp. Alg.* 2, *p.* 320. *Chondrus Norvegicus*, *Lamour.—Harv. Phyc. Brit. t.* 187. *Oncotylus Norvegicus*, *Kütz. Sp. Alg. p.* 789. *Fucus Norvegicus*, *Turn. Hist. t.* 41. *E. Bot. t.* 1080. *Chondrus dubius*, *Mont. Fl. Alg. p.* 117.

Hab. Penobscot Bay, Maine, *Mr. J. Hooper.* (v. v.)

The only American specimen of this species which I have yet seen is two inches long, about a line in diameter, and irregularly dichotomous ; about four or five times forked, the segments linear, divaricating, and the axils remarkably rounded. It bears two or three young nemathecia ; and the cellular structure is exactly as in the European plant. Notwithstanding the northern locality from which it comes, Mr. Hooper's specimen much more nearly resembles the narrow Algerian variety called *Chondrus dubius* by Montagne, than any specimen I possess from the English or Irish coasts.

4. Gymnogongrus *linearis*, J. Ag. ; frond stipitate, slightly channelled or flattish, dichotomous, fastigiate ; segments linear, somewhat thickened at the margin, very entire, the terminal ones obtuse, rounded, and dilated ; nemathecia sub-globose, plentiful on the upper laciniæ, and almost always protruded on the concave surface of the lobe. *J. Ag. Sp. Alg.* 2, *p.* 325. *Chondrus linearis*, *Grev.—Kütz. Sp. Alg. p.* 738. *Fucus linearis*, *Turn. Hist. t.* 220.

Hab. At Port Trinidad, Pacific Coast, Lat. 41° 12′ N., *A. Menzies, Esq.* (v. s. in Herb. Menzies).

Frond four to six inches high, stipitate. *Stipes* sub-cylindrical, and as thick as a crow's quill at the base, very soon compressed, then flattened, somewhat channelled, one to two lines in diameter, two to three inches long, forked at the summit, after which the flabelliform frond is repeatedly dichotomous. *Laciniæ* linear, slightly channelled, the terminal ones broader and cuneate, very obtuse or subemarginate ; or else bifid, each apex truncate. *Nemathecia* very convex, as large as rapeseed. *Colour* a dark red-brown, more rufous in the tips. *Substance* cartilaginous. It does not adhere to paper in drying.

In aspect this species is not unlike *Chondrus crispus*, but is widely different in structure.

IV. AHNFELTIA. *J. Ag.*

Frond cartilagineo-corneous, subterete, dichotomous or secundly proliferous, composed of two strata or cells ; the medullary stratum of very slender, densely packed

elongated cells, longest towards the centre, shorter toward the margin ; the cortical of moniliform, vertical, closely packed, short filaments formed of minute coloured cellules. *Conceptacular nucleus* immersed in the frond, sub-prominent, consisting of several associated *nuclei* or masses of minute spores. *Nemathecia* (?) external, surrounding the branches, wart-like, formed of radiating, very densely packed, slender filaments. . . . . .

Nearly related apparently to the last genus, with which I have formerly felt disposed to unite it. It differs, however, in the much greater density of cellular structure and more rigid substance of the frond. The typical species, *A. plicata*, is widely dispersed, being common on both shores of the Atlantic, in the Pacific Ocean, and extending into high southern latitudes. The other species are local, and comparatively little known.

1. Ahnfeltia *plicata*, Fries ; frond horny, terete, filiform, very irregularly branched, entangled ; branches di-trichotomous, with lateral proliferous often secund ramuli ; axils rounded, apices curving upwards, the terminal shoots elongate. *J. Ag. Sp. Alg.* 2, *p.* 311. *Gymnogongrus plicatus*, *Kütz. Sp. Aly. p.* 789. *Harv. Phyc. Brit. t.* 288. *Fucus plicatus*, *Turn. Hist. tab.* 180. *E. Bot. tab.* 1089. *β. fastigiata ;* frond more regularly dichotomous, the apices of equal length, *Gymnogongrus fastigiatus Post. and Rupr.! Alg. Russ. p.* 16.

Hab. Boston Bay, *Mr. G. B. Emerson*, *Dr. Asa Gray*, &c. Rhode Island, *Prof. Bailey.* New York, *Mr. Calverley. β.* Unalaschka, *Wosnessensky!* Halifax, *W. H. H.* Boston Bay, *Mr. Emerson.* (v. v.)

Fronds densely tufted, often forming intricate bundles some inches in diameter and 9 or 10 inches long. *Stems* filiform, twice as thick as hog's bristle, very irregularly branched, more or less dichotomous, especially below ; the lesser divisions often lengthened and beset with lateral alternate or secund, erecto-patent branchlets. In var. *β.* the tufts are often perfectly level-topped as if clipped with a shears ; the fronds regularly dichotomous with distant lower forks and approximate upper ones. *Colour* a blackish purple. *Substance* very rigid and wiry. It does not adhere to paper in drying.

I have been favoured by Dr. Ruprecht with an original specimen of his *Gymnogongrus fastigiatus*, but can by no means distinguish it from a fastigiate variety of *A. plicata* which accompanies the ordinary form in Boston and Halifax Harbours.

2. Ahnfeltia *gigartinoides*. J. Ag. ; "frond carnoso-corneous, terete, dichotomous and secundly decompound-proliferous ; the proliferous ramuli very patent, obtuse ; the segments erect from the rather acute axils, the terminal ones elongate." *J. Ag. Sp. Alg.* 2, *p.* 311. *Gymnogongrus gigartinoides*, *Kütz. Sp. Alg. p.* 789.

Hab. On the Pacific Coast of the Mexican Republic, *Liebman !* (v. s. in Herb. T. C. D.)

Closely related to the preceding species, but more robust (half a line in diameter), and softer when moistened, soon decomposing if kept in fresh water.

3. Ahnfeltia ? *pinnulata ;* frond rigid, terete, irregularly branched ; branches few, elongate, subsimple, compressed above, and more or less closely pinnulated with setaceous, short ramuli.

Hab. At Key West, rare, *W. H. H.* (42.) (v. v.)

Frond twice as thick as a hog's bristle, 4—5 inches long, terete below, subcompressed above, very irregularly branched, and chiefly from the lower part. Branches long, arched or straight, sub-simple, either quite naked or set at distances of a line or two apart with setaceous, horizontally patent ramuli. These are two to four lines long, alternate or opposite, sometimes fasciculate or imperfectly whorled, but mostly distichous, as thick as a hog's bristle, distant or crowded. *Colour* a dull, blackish purple. *Substance* rigid and wiry, as in *A. plicata.* The structure of the medullary stratum is very compact and dense, and nearly as in *A. plicata ;* but the cortical stratum is very narrow, composed of very minute cells, in few rows.

I found but two specimens of this plant at Key West. It seems to me to be a well-marked species, and related to the plants of this genus, if not a genuine congener; a fact which cannot be ascertained without more complete data.

V. CYSTOCLONIUM. *Kütz.*

Frond carnoso-membranaceous, terete, decompoundly branched, composed of three strata of cells; medullary stratum cord-like, formed of elongated, longitudinal, interwoven confervoid filaments, anastomosing and dichotomous, their branches arching outwards among the large rounded cells of the intermediate stratum ; cells of the cortical stratum small, roundish-angular. *Conceptacles* half immersed in the branches, containing within a thick closed pericarp (formed from the cortical layer) a compound *nucleus*, consisting of several nucleoli or masses of minute spores, separated by sterile filaments. *Tetraspores* dispersed through the cortical layer of the branches, zonate.

This genus, as originally proposed and admirably illustrated by Kützing, in his Phycologia Generalis (p. 404, t. 58, fig. I.) is readily distinguished from all neigh-

bouring genera by the structure of the frond detailed above. In external habit the typical species more resembles the *Gracilario*, among which it was placed by Dr. Greville ; or the *Hypneæ* (among which, in the Phycologia Britannica, I most unnaturally intruded it) than any of the genera with which the structure of its sporiferous nucleus associates it. In the structure of the frond, as well as in habit, there is a near approach also to *Rhabdonia*, and to *Solieria ;* from both which genera, as well as from *Gracilaria* and *Hypnea*, the structure of the nucleus widely separates it. This latter character, obviously the first in value as indicating natural affinities, brings it into the present Order. *Cystoclonium purpurascens*, our only species, is common throughout the Northern Atlantic, extending on the European side from the glacial ocean to the southern coasts of France.

1. Cystoclonium *purpurascens*, Kütz. ; frond terete, sub-pinnately decompound, much branched ; branches alternate, elongate, set with alternately decompound ramuli which taper to each end ; conceptacles lodged in the ramuli, one or more forming nodose swellings in each ramulus. *J. Ag. Sp. Alg.* 2, *p.* 307. *Kütz. Sp. Alg. p.* 756. *Hypnea purpurascens*, *Harv. Phyc. Brit. t.* 116. *Fucus purpurascens*, *Turn. Hist. t.* 9. *E. Bot. t.* 1243. *β. cirrhosa ;* the branches drawn out into long, twisted tendrils.

Hab. On littoral fuci, &c. Common from Halifax to New York Harbour. Squan, New Jersey, *Miss E. Morris.* *β.* Rye Beach, New Hampshire, *Miss Frothingham.* (v. v.)

Fronds six to twelve inches long or more, as thick as a crow's quill below, attenuated upwards, excessively branched and bushy, alternately decompound ; main branches lateral, elongate, spreading, set with two or more series of smaller branches, the last bearing irregularly scattered subulate ramuli: branches and ramuli acute, tapering to the base. *Conceptacles* imbedded in the ramuli, one, two, or more in each, forming a chain of nodes, the conceptacle being much wider than the place where it is lodged. *Colour* a dark brownish purple or brown, sometimes pale. *Substance* between cartilaginous and membranaceous, shrinking in drying. The frond imperfectly adheres to paper.

β. is a singular form in which the ramuli are converted into spirally twisted tendrils, which coil round neighbouring plants.

VI. CALLOPHYLLIS. *Kütz.*

Frond carnoso-membranaceous, blood-red or rosy, flat, dichotomous or sub-pinnate, formed of two strata of cells ; the medullary stratum of large roundish cells,

smaller toward the surface, each cell surrounded by a net-work of anastomosing cellules; cortical stratum formed of vertical, moniliform filaments. *Conceptacles* immersed in the disc or margin, sub-prominent, roundish, containing within a closed pericarp (formed from the cortical layer) a compound nucleus consisting of several nucleoli or masses of minute spores, separated by a net-work of slender fibres. *Tetraspores* immersed in the frond, scattered, cruciate.

A genus of splendidly-coloured Algæ, chiefly natives of the southern hemisphere. Fronds blood-red, or scarlet-lake, flat, nerveless, dichotomous or somewhat palmate, the laciniæ broader upwards, lobed at the extremity, and frequently fimbriate along the margin. The internal structure of the frond is very peculiar. The medullary portion consists of two or more, sometimes of many, rows of large, empty cells separated by narrow interspaces, through which a delicate net-work of cob-webby filaments permeates. The cortical layer is formed of more or less evolved moniliform, vertical, coloured filaments, set in firm transparent gelatine. Formerly these plants were included in *Rhodymenia*, of which genus they have externally the habit, but from which they abundantly differ in the structure of the frond and of the sporiferous-nucleus.

1. Callophyllis *laciniata*, Kütz.; frond sub-cartilaginous, bright red, palmate or flabelliform, cleft into numerous, broad, wedge-shaped segments which are again divided dichotomously; apices obtuse; the margin of fertile specimens curled and fringed with minute ciliary processes, in which the conceptacles are lodged. *J. Ag. Sp. Alg.* 2, *p.* 299. *Kütz. Sp. Alg. p.* 744. *Rhodymenia laciniata*, *Grev.—Harv. Phyc. Brit. t.* 121. *Fucus laciniatus*, *Turn. Hist.* 69. *E. Bot. t.* 1068.

Hab. Pacific coast, *Mr. Menzies!* 1788. California, *Beechey.* Atlantic coast, at Cape Henlopen, *Miss Morris.* (v. v.)

Apparently very rare on the American coast. I have as yet only seen a solitary, small, but unmistakable specimen from the Atlantic side of the Continent; and it is difficult to conceive that so conspicuous a plant should be overlooked by collectors were it not extremely rare.

VII. KALLYMENIA. *J. Ag.*

Frond carnoso-membranaceous, flat, irregularly cleft or divided into indefinitely-circumscribed lobes, composed of three strata of cells; the medullary stratum of densely interwoven, branching and anastomosing articulated filaments; the inter-

mediate of large, roundish-polygonal, seriated cells; the cortical of minute, roundish, vertically seriated cellules. *Conceptacles* immersed in the frond, prominent to both surfaces, roundish, containing within a sub-definite pericarp (formed from the cortical layer) a compound nucleus consisting of several nucleoli or masses of minute spores. *Tetraspores* formed from the superficial cellules, scattered, cruciate.

Fronds intensely and generally brilliantly coloured, blood-red or crimson lake, rarely purplish or brownish, of a thickish, membranous, or somewhat cartilaginous substance, soft to the touch, flat, either quite sessile or somewhat stipitate, irregular in form and in division. In the young state the lamina is generally quite simple, roundish, oblong, obovate or reniform; but in age, either from a natural tendency to split, or from the action of the waves, it becomes much divided; sometimes reduced to narrow ribbons; and sometimes, by new proliferous growths from the injured margin, fringed with small lobes or frondlets. Several species have been described, but owing to the great irregularity of form, they are difficult to characterise, and botanists are not agreed as to their exact limits. I have now to add one to the number, which, though founded on very imperfect specimens, I am unwilling to omit from the present Essay.

1. Kallymenia *Pennyi*.

Hab. Dredged on a shingly bottom, in 15—20 fathoms water, in Assistance Bay, Arctic coast, *Dr. Sutherland*, (v. s. in Herb. T. C. D.)

Fragments of leaves three to five inches long, and three to four inches broad, but too much injured to enable me to determine the proper outline, are all that I have yet seen of this supposed new species. They resemble *K. reniformis;* but when thin slices of both are placed together on the table of the microscope, the membrane of *K. Pennyi* is seen to be only half the thickness of that of *K. reniformis*, with the medullary net-work more lax, and the cortical cellules larger. The structure seems essentially the same. The colour of the dried specimens is a dark, full-red, somewhat brownish.

At the request of my friend Prof. Dickie of Belfast, I name this interesting plant in honour of the intrepid commander of the Arctic Searching Expedition, *Capt. Penny*, "by whose energy and determination Dr. Sutherland was enabled to reach the locality where it was found." *Dickie in litt.*

VIII. CONSTANTINEA. *Post. and Rupr.*

Frond caulescent, branched; branches sub-terete, expanding into carnoso-coriaceous, flat, definite laminæ, composed of three strata of cells; the medullary stratum of sparingly anastomosing, interwoven, articulated filaments; the intermediate of rounded cells; the cortical of very minute, coloured cellules. *Conceptacular nucleus* immersed in the substance of the leaves, consisting of numerous nucleoli, each surrounded with a gelatinous limbus, and containing a mass of minute spores. *Tetraspores* lodged in external *warts* (*nemathecia*), oblong, zonate.

Nearly related to the preceding genus in artificial character, but differing in the position of the tetraspores, and very dissimilar in external form. Instead of vaguely shaped, stemless fronds, we have here a regularly branching frond, furnished, from its earliest age, with a distinct stem. At first the stem is simple, bearing at its summit a peltate or reniform lamina: by a renewed growth the stem pushes onward through the base of the first leaf (which thus becomes perfoliate or amplexicaul to the new stem) and forms a new leaf at its summit; and so the frond lengthens, new leaf-bearing internodes continually rising through the bases of the older leaves. After a while they spring in pairs from each leaf-base, and thus the branching becomes normally dichotomous; but as one internode of the fork is often abortive, old specimens are frequently irregularly decompound.

Three species of this curious genus are known; two of them confined to high latitudes in the Pacific Ocean; the third to very deep water in the Mediterranean Sea, having been dredged by Prof. Edwd. Forbes in 50 fathoms.

1. Constantinea *Sitchensis*, Post. and Rupr.; "stem terete, branched, annulated; internodes separating the rings four times as long as their diameter; branches expanded at the summit into an orbicular, peltate, entire lamina." *Post. and Rupr. Illustr. p.* 18, *t.* 40, *f.* 88. *J. Ag. Sp. Alg.* 2, *p.* 295. *Neurocaulon Sitchense*, *Kütz. Sp. Alg. p.* 744.

Hab. Isle of Sitcha, Russian America.

I have seen no specimens of this rare and singular Alga.

IX. GIGARTINA. *Lamour.* (J. Ag. ref.)

Frond carnoso-cartilaginous, flat or cylindrical, simple or variously branched, composed of two strata of cells ; the medullary stratum of cylindrical, articulated filaments, anastomosing into a very lax net-work ; the cortical of moniliform, vertical, dichotomous filaments set in firm gelatine. *Conceptacles* external, globose, finally perforate, containing within a saccate *placenta* (?) formed of closely interwoven filaments, a compound *nucleus* consisting of many confluent *nucleoli* or masses of roundish-angular spores. *Tetraspores* collected into dense, sub-prominent sori, lodged beneath the superficial cells, roundish, cruciate.

Fronds very variable in external habit, sometimes filiform, and either pinnated or dichotomously multifid : sometimes compressed or channelled on one side, sometimes completely flat. The flat species are often expanded into broad, leaf-like, simple or proliferously ramose fronds. The substance in all is thick, between fleshy and cartilaginous, elastic and generally tough when recent ; firm, crisp, and somewhat horny when dry. The structure in all is very similar, the inner stratum of the frond consisting of a very lax network of filaments traversing a pellucid gelatine ; the outer of vertical, dichotomous, moniliform filaments issuing from the outer meshes of the internal network. (See Plate XXVII. C. *fig.* 3.)

This genus, as reconstructed by Prof. J. G. Agardh, is very closely related on the one hand to *Iridæa* and on the other to *Chondrus*. From the former it is only to be known by having its *nuclei* lodged in external conceptacles, instead of being wholly immersed in the frond ; from the latter by the same character, and by having the nucleus protected by a closely woven coccoon-like plexus of filaments. Some of the species have the external habit of *Chondrus*, in which genus they were formerly placed, and others as strongly resemble species of *Iridæa*.

Sect. 1. Eu-gigartina. *Fronds linear, compressed or subterete, pinnately compound. Conceptacles sessile, marginal on the pinnules.*

1. Gigartina *canaliculata*, Harv. ; frond linear, concave on one surface, convex on the other, naked below, forked or irregularly branched beyond the middle ; branches distichously pinnate or bi-pinnate ; pinnæ patent ; pinnules short, spine-like, divaricating ; conceptacles formed in abbreviated, spiniferous pinnæ. *Harv. in Beechey Voy. p.* 490. *J. Ag. Sp. Alg.* 2, *p.* 272. *Chondroclonium canaliculatum, Kütz. Sp. Alg. p.* 741. (Tab. XXVII. C.)

Hab. Shores of California, *Douglas, Coulter, Capt. Pike* (26, 30.) (v. s. in Herb. T. C. D.)

Root accompanied by creeping, branched fibres which throw up numerous, erect stems. *Fronds* densely tufted, two to four inches high, from half a line to a line in breadth, nearly flat, but the margins incurved towards one side, making a channel in the middle of the disc ; the *stem* naked for an inch or more above the base, then forked, the segments either simple or again forking, naked below, closely pinnated or bi-pinnate in the upper half. *Pinnæ* distichous, opposite or irregularly placed, from a quarter to half an inch or more long, very patent, simple or set with divaricating, spine-like pinnules. The pinnules in some specimens are mere thorn-like ramuli, but in others are multifid, either irregularly so, or somewhat dichotomous, all the ultimate divisions being remarkably squarrose. *Apices* acute. *Conceptacles* imbedded in the substance of the pinnæ or pinnules, one or more in each, very frequently armed with minute awl-shaped spines, colour very dark blackish purple. *Substance* cartilaginous. It does not adhere to paper in drying unless previously softened by long steeping in fresh water.

A well marked species, probably not uncommon on the Pacific coast.

Plate XXVII. C. *Fig.* 1. Gigartina *canaliculata* ; the *natural* size. *Fig.* 2, portion of a frond with conceptacles ; somewhat *magnified*. *Fig.* 3, longitudinal slice of a branch, showing the internal structure ; highly *magnified*.

2. Gigartina *mollis*, Bail. and Harv. ; frond cartilaginous, plano-compressed, linear, distichous, pinnately branched ; branches alternate or opposite, erect, tapering at the base, naked below, pinnated above ; ultimate ramuli narrow, sub-filiform. *B. and H. in Bot. Expl. Exped.*

Hab. Pacific Coast at Puget's Sound, *Capt. Wilkes.* (v. s. in Herb. Expl. Ex.)

Frond three to four inches high, from one to two lines in breadth, distichously branched, once, twice, or thrice pinnated, the pinnæ (and pinnules) all very erect, naked below, closely set with pinnules above, narrowed to the base and apex, sometimes forked and then each division pinnated. *Colour* purple. *Substance* cartilaginous, soon decomposing if moistened after having once been dried, and then closely adhering to paper in drying.

Of this I have only seen the few specimens collected in Capt. Wilkes' Expedition. So far as these enable me to speak, the species appears different from any previously described.

Sect. 2. Mastocarpus, Kütz. *Frond thick, dichotomous or sub-pinnate, the segments flat, widening upwards, cuneate or oblong, sometimes very broad. Conceptacles formed in papilliform processes issuing from both surfaces of the expanded frond.*

3. Gigartina *mamillosa*, J. Ag. ; frond flattish, channelled, linear, decompound-dichotomous, fastigiate ; upper segments wedge-shaped, bifid ; papillæ issuing from the disc and margin, tongue-shaped, each containing a single roundish conceptacle.

J. Ag. Sp. Alg. 2, *p.* 273. *Harv. Phyc. t.* 199. *Mastocarpus mamillosus*, *Kütz. Sp. Alg. p.* 733.

Hab. Newfoundland, *Agardh.* Penobscot Bay, *Dr. Aaron Young!* Newburyport, Massachusetts, *Capt. Pike!* Unalaschka, *Lutke!* California, *Dr. Coulter!* (v. v.)

Frond three to six inches high, either regularly or very irregularly dichotomous. flattish, channelled on one side, convex on the other, the segments more or less broadly wedge-shaped, simple or forked, the primary ones in the old specimens throwing out, in a proliferous manner from their surface, numerous similar wedge-shaped, channelled simple or forked secondary segments. *Margin* of the frond incurved, either quite entire and simple, or fringed with small lobes. The surface of all the segments, primary and secondary, especially on the concave side, is very frequently densely set with lobules, or filiform or mamilliform processes of various lengths, some mere tubercles, others linear-wedge-shaped frondlets from a quarter to half an inch long. In these the roundish or ovate *conceptacles* are lodged. *Colour* a very dark purple. *Substance* rigid, somewhat horny when dry. It does not adhere to paper.

The specimens from Unalaschka are broader and shorter than those from California. I have not seen any from Newfoundland.

4. Gigartina *microphylla*, Harv. ; frond foliaceous, flat, lanceolate, mostly simple (occasionally bifid or trifid), attenuated to the base into a long, slender, linear-cuneate stipe ; both surfaces very densely echinate with minute spindle-shaped soriferous papillæ, and the margin fringed with similar processes. *Rhodymenia? microphylla*, *Harv. in Beech. Voy. p.* 164. *Mastocarpus Harveyanus*, *Kütz. Sp. Alg. p.* 734. (Tab. XXVIII. A.)

Hab. Monterey, California, *Douglas! Coulter!* (v. s. in Herb. T. C. D.)

Root expanded, fleshy, composed of many confluent discs. *Fronds* tufted ; the stipes at first cylindrical, as thick as a sparrow's quill, soon flattened, gradually widening upwards for two or three inches ; then either forked or trifid, or simply passing into the base of a linear-lanceolate leaf-like lamina, twelve or fourteen inches long or more, an inch or an inch and half wide, and gradually fining off to an acute point. Both surfaces of the lamina are densely clothed with minute, subulate or spindle-shaped processes ; and the margin is also closely fringed with similar ones, which are sometimes lengthened out into marginal lobes from half an inch to an inch in length, and fringed and muricated like the primary leaf. In fertile specimens the papillæ are incrassated. *Sori* one or more in each papilla, immersed, globose, consisting of moniliform strings of cruciate tetraspores. I have not seen conceptacles. *Substance* cartilaginous, thinner than in *G. Radula*. *Colour* a deep, brownish red.

Plate XXVIII. A. *Fig.* 1. Gigartina *microphylla ;* the *natural* size. *Fig.* 2, small portion of the lamina, with four fertile, soriferous papillæ ; *magnified. Fig.* 3, section of a papilla, through a *sorus*, and 4, a *tetraspore ;* both highly *magnified.*

5. Gigartina *spinosa*, Kütz. ; frond somewhat channelled below, thick, cuneate at the base, linear-lanceolate, simple or once or twice forked (the segments sometimes sub-pinnate) ; the margin fringed, and the surface densely muricated with mamilliform or filiform, simple or multifid, acute processes, in which the conceptacles are immersed. *Mastocarpus spinosus, Kütz. in Bot. Zeit.* 1847, *p.* 21. *Iridæa stiriata, Harv. in Beech. Voy. p.* 409. (*Excl. Syn.*) *Gigartina ornithorhynchos, J. Ag.* 1849. *Sp. Alg.* 2, *p.* 274. (Tab. XXVIII. B.)

Hab. California, *Douglas ; Coulter.* (v. s. in Herb. T. C. D.)

Root discoid. *Fronds* densely tufted, six to eight inches long, flat or somewhat channelled below, rising with a short cylindrical stem, as thick as a crow's quill, which soon becomes flattened, and gradually widens into the base of the linear-lanceolate lamina. *Lamina* either simple, tapering to both ends, or more frequently once or twice forked, or irregularly 3—4 cleft vertically, the segments in the dichotomous varieties cuneate, those of the others more lanceolate and longer. In some specimens the margin is pinnated with lanceolate or linear wing-like lobes an inch or more in length. Both surfaces are bristled with spine-like, obtuse or acute, simple or compound papillæ in which the conceptacles are borne. *Conceptacles* as large as rape-seed, globose, immersed in the middle or towards the end of the papillæ, the subulate apex of which often extends beyond the conceptacle like the bill of a bird. *Colour* a dark red brown or dull purple. *Substance* coriaceo-cartilaginous, thick and coarse. In drying it shrinks considerably, and does not adhere to paper.

I formerly confounded this species with *G. stiriata*, to which some of the specimens bear a near resemblance, but our plant is less thick and much less gelatinous, and appears to be sufficiently characterised.

Plate XXVIII. B. *Fig.* 1. Gigartina *spinosa ;* the *natural* size. *Fig.* 2, a compound papilla, bearing several conceptacles ; *magnified. Fig.* 3, segment of a thin section of a conceptacle, shewing a portion of the external wall and of the compound nucleus ; *fig.* 4, *spores* from the same ; both highly *magnified.*

6. Gigartina *exasperata*, Bail. and Harv. ; frond stipitate ; stipes expanding into a coriaceo-membranaceous, broadly lanceolate, entire frond, incrassated at the margin, eroso-dentate and with marginal lobules, both surfaces densely muricated with simple or branched spinous processes in which the conceptacles are lodged. *Bail. and Harv. in Bot. Expl. Exped.*

Hab. Fort Nesqually, Puget's Sound, *Captain Wilkes.* (v. s. in Herb. Expl. Exp.)

Frond two to three feet long, six to ten inches wide, rising with a short stem which soon dilates into a simple, lanceolate lamina, jagged and irregularly dentate at the margin, and rough all over both surfaces, with short simple or forked spines. *Substance* thin, but coriaceous when dry. *Colour* a fine purple. *Conceptacles* formed towards the base of the lamina, in the marginal or discal spines.

Nearly allied to *G. Radula*, but much thinner in substance.

7. Gigartina *Radula*, J. Ag.; frond stipitate; stipes somewhat channelled, simple or branched; the branches expanding into thick, fleshy, flat, oblong, ovate, elliptical or obovate entire laminæ, which are either naked or densely muricated with papilliform processes, in which the conceptacles are imbedded. *J. Ag. Sp. Alg.* 2, *p.* 278. *G. papillata, Harv. in Beechey* (*not of Ag.*) *Mastocarpus corymbiferus, Kütz. Sp. Alg. p.* 734. *Fucus bracteatus, Turn. Hist. t.* 25.

Hab. North West Coast, *Menzies.* California, *Douglas; Coulter, Capt. Pike,* (v. v.)

Fronds (in the Californian specimens) six or twelve inches long or more, three to four inches wide, cuneate or slightly channelled at the base, obovate, obtuse or subacute, sometimes ovato-lanceolate, thick, carnoso-coriaceous, the upper half more or less densely echinate on both surfaces, with mamilliform, acute or obtuse, simple or multifid processes. *Colour* a dark brownish red. A very variable species, common in the Southern hemisphere and on the Pacific coasts. The Californian specimens which I formerly referred to *G. papillata*, Ag. are pretty constantly obovate and quite simple, obtuse, tapering much to the base; but some are lanceolate, and one is very irregular in shape. At the Cape of Good Hope, where this species is profusely common, many forms occur together; some having perfectly simple fronds; others dividing near the base into many segments, or secondary fronds, each of which is stipitate, ovate, obovate or lanceolate. In others each segment is deeply bifid, and in others the frond is somewhat palmate. Specimens bearing tetraspores are quite smooth, destitute of papillæ.

On a careful comparison of the Californian specimens on which Kützing's *Mastocarpus corymbiferus* is founded, with numerous specimens of *G. Radula* collected at the Cape, I do not see how they are to be distinguished: and this opinion is formed from an examination of a much fuller suite of specimens than Kützing, to whom I communicated those which he describes, had before him.

X. IRIDÆA. *Bory.*

Frond gelatinoso-carnose, flat, subsimple, composed of two strata of cells; the medullary stratum of cylindrical, articulated filaments, anastomosing into a very lax

net-work ; the cortical of moniliform, vertical, dichotomous filaments, set in a firm gelatine. *Sporiferous nucleus* immersed in the substance of the frond, roundish, enclosed in a saccate placenta (?) formed of closely interwoven filaments, consisting of many confluent *nucleoli* or masses of minute spores. *Tetraspores* collected into dense sori lodged beneath the superficial cells, roundish, cruciate.

Technically this genus can only be distinguished from *Gigartina* by having its *nuclei* immersed in the inner substance of the frond, and not contained in external tubercles or conceptacles. The structure of the frond is similar in both genera, but the *Iridææ* have generally simpler, less regularly cleft, and more widely expanded laminæ, of a brighter colour and more glossy surface. Their substance is soft, between fleshy and membranous when fresh, somewhat cartilaginous when dry, soon dissolving into gelatine if again moistened after having been once dried. Many species have been described, but I fear often on insufficient data, and I regret that the materials at my command are insufficient to enable me to say, whether all or how many of the following species ought to be retained.

1. Iridæa *minor*, J. Ag.; "frond ovate oblong, sub-simple, smooth, abruptly attenuated into an evident, flattish stipes." *J. Ag. Sp. Alg.* 2, *p.* 252.

Hab. California, *Douglas*.

"Fronds gregarious, 2—3 inches high, an inch broad, rising with an elongated flattish stipes nearly an inch long, then abruptly cuneately expanded into an ovate or oblong, entire lamina, which is either smooth or verrucated with sub-prominent conceptacles ; rounded and very obtuse at the apex. *Colour* livid, brownish. *Substance* gelatinous, cartilaginous when dry." *J. Ag.*

2. Iridæa *laminarioides*, Bory ; frond stipitate, linear-obovate or sub-lanceolate, simple or cloven into numerous narrow obovate or lanceolate laciniæ ; nuclei densely scattered, sub-prominent. *J. Ag. Sp. Alg.* 2, *p.* 253. *Kütz. Sp. Alg. p.* 726.

Hab. Russian America, *Postels and Ruprecht.* California, *Douglas ! Coulter !* (v. s. in Herb. T. C. D.)

Stipes one to two inches long, cylindrical at the base, soon cuneate and compressed, gradually widening to half an inch, and then suddenly expanding into the base of a narrow, obovate or oblong, linear frond, one to two feet long, obtuse, or more or less acute or acuminate at the apex. Sometimes the frond divides a little above the apex of the stipes into numerous frondlets ; but this chiefly takes place in spe-

cimens which have grown again after having been injured. Barren specimens are perfectly smooth ; nucleiferous ones are densely verrucose with the very abundant, closely set, depressed, hemispheroidal *nuclei*. Specimens containing *tetraspores* are smooth, but closely dotted over the surface with minute, deep coloured sori. *Colour* a dull brown red, sometimes purplish, fading into greenish. *Substance* rather thick, coriaceous, not very glossy.

My specimens from Douglas (can they be Agardh's *J. minor ?*) are smaller than some of those from Dr. Coulter, but appear to be specifically the same.

3. Iridæa *cordata*, J. Ag. ; "frond cordate-ovate, sub-acuminate, smooth, abruptly passing into a very short channelled stipes." *J. Ag. Sp. Alg.* 2, *p.* 254. *Fucus cordatus*, *Turn. Hist. t.* 116.

Hab. Banks Island, on the N. W. Coast, *Menzies.*

Fronds said to be about a foot long and six inches wide, oblong-cordate, subacute, flattish or undulate at the margin.

4. Iridæa *punicea*, Post. and Rupr. ; " lamina membranaceous, orbicular in outline, fixed by the margin or lower surface, plaited, here and there perforated, entire or eroso-dentate, of a deep crimson-lake colour." *Post. and Rupr. Illustr. p.* 18.

Hab. Isle of Sitcha, *Postels and Ruprecht.*

5. Iridæa *pinnata*, *Post. and Rupr.* ; " lamina membranaceous, thickened, linear, regularly bi-tripinnate, purple ; pinnæ and pinnules linear, divaricate, narrowed at the base, very entire or ciliato-pinnate at the margin." *Post. and Rupr. Illust. p.* 18.

Hab. Norfolk Bay, N. W. Coast, *Postels and Ruprecht.*

Said to resemble *Calliblepharis jubata* in habit, but to have the structure of *Iridæa.* May it not rather be a species of *Gigartina*, possibly our *G. mollis?*

XI. CHONDRUS. *Stack.*

Frond carnoso-cartilaginous, flat, dichotomous, fastigiate, composed of two strata of cells ; the medullary stratum of cylindrical, articulated filaments anastomosing

into a dense network ; the cortical of moniliform, vertical filaments, set in firm gelatine. *Sporiferous nuclei* immersed in the substance of the frond, somewhat prominent toward one surface, roundish, consisting of many confluent *nucleoli* or masses of minute spores. *Tetraspores* collected into dense sori lodged beneath the superficial cells, roundish, cruciate.

A small genus better distinguished from *Iridæa* by its external habit and firmly cartilaginous substance than by any structural character. Its type in the well-known *Chondrus crispus* or Carrageen (Irish moss), a common littoral plant on both sides of the Atlantic.

1. Chondrus *crispus*, Lyngb.; frond stipitate, flabelliform, dichotomous, fastigiate, flat, the segments linear-cuneate ; nuclei oval, prominent to one surface of the frond, depressed to the other. *J. Ag. Sp. Alg.* 2, *p.* 246. *Harv. Phyc. Brit. t.* 63. *Kütz. Sp. Alg. p.* 735. *Fucus crispus, Linn.—Turn. Hist. t.* 216, 217. *E. Bot. t.* 2285.

Hab. Rocks between tide marks, common on the Atlantic Coast from the shores of British America to those of Long Island. (v. v.)

Frond three to six inches high or more, stipitate, the stipes 1—2 inches long, narrow cuneate, gradually widening to the first fork. *Lamina* flabelliform, fastigiate, many times regularly dichotomous, with patent, rounded axils ; apices either obtuse or acute. In some specimens the width of the laciniæ is only a line or two, and they are nearly of equal breadth throughout ; in others the laciniæ are half an inch to an inch or more in breadth, decidedly wedge-shaped, flat or very much curled. The substance is between horny and cartilaginous, rigid when dry. *Colour* varying from a dull livid purple to greenish and yellowish. Sori of *tetraspores* (like little drops of blood) scattered over the segments.

2. Chondrus *affinis*, Harv. ; frond stipitate, flabelliform, dichotomous, slightly concave or channelled on one side, convex on the other ; segments linear-wedge form ; nuclei abundant, scattered through the segments, prominent to both surfaces. *Harv. in Beech. Voy. p.* 408. *J. Ag. Sp. Alg.* 2, *p.* 247. *Kütz. Sp. Alg. p.* 737.

Hab. California, *Douglas ; Coulter.* (v. s. in Herb. T. C. D.)

Densely tufted, two to four inches high. *Fronds* rising with a linear, wedge-form stipes, one to two inches long, and somewhat channelled, then forking, and afterwards repeatedly dichotomous, with patent, linear, or wedge-form, slightly chan-

nelled segments and rounded axils; the upper divisions not always regularly dichotomous, but sometimes winged with lateral, secondary segments. Margin of the frond a little thickened and inflexed. *Nuclei* as large as poppy-seed, thickly scattered over the segments, spheroidal, most prominent to the channelled surface of the frond, slightly convex to the convex surface. The plexus of filaments composing the medullary stratum is very lax; the filaments of the cortical layer are minute, moniliform, and densely set. *Colour* a dark, brownish purple. *Substance* cartilaginous. It scarcely adheres to paper.

This plant closely resembles *C. crispus* in external character, but is of a much softer substance and laxer structure, soon decomposing in fresh water.

XII. ENDOCLADIA. *J. Ag.*

Frond terete, cartilaginous, much branched, muricated with minute spines; the *axis* consisting of a single, articulated, monosiphonous filament, coated with minute cells, from which issue whorls of horizontal, radiating, dichotomous, fastigiate, moniliform filaments, whose apices, united by a firm gelatine, form the exterior coat or *periphery* of the frond. *Conceptacles* hemispherical, sessile on the ramuli, containing, within a closed pericarp, numerous laxly aggregated *nucleoli* of angular spores. *Tetraspores* (according to Kützing) exserted, seriated, aggregated in amorphous nemathecia bursting from the tumid upper branches.

A curious and distinct genus, consisting of two species, one of them a native of the Southern Atlantic, the other of the North Pacific Ocean. The frond has externally the habit of a small *Gigartina*, but a cross section of the stem, as shown in our *Plate XXVII. B. fig* 4, shows a very different structure.

1. Endocladia *muricata*, J. Ag.; frond densely tufted, irregularly much branched; branches flexuous, variously divided, set in the upper part with numerous, divaricated, awl-shaped ramuli; the whole frond muricated with very minute, conical or bifid spinules. *J. Ag. Sp. Alg.* 2, *p.* 237. *Gigartina muricata*, *Harv. in Bot. Beechey*, *p.* 409. *Post. and Rupr. Illust. p.* 16. *Kütz. Sp. Alg.* 2, *p.* 751. *Acanthocladia muricata and A. hamulosa*, *Rupr. ! !* (Tab. XXVII. B.)

Hab. Sitcha, *Dr. Mertens !* California, *Beechey ! Coulter ! Wosnessensky ! Capt. Pike !* (v. s. in Herb. T. C. D.)

Fronds densely tufted, an inch or two in height, as thick or twice as thick as hog's bristle, irregularly branched; stems either sub-simple, or once or twice forked, flexuous, having several arching, simple or sub-simple lateral branches, beset, especially toward the ends, with short, crowded, similar branchlets. Both primary and

secondary branches taper to a fine point, and are muriculated on all sides with very minute, broadly subulate or conical, simple or slightly bifid spines. The frond is formed of a simple, jointed axial filament of large diameter, with internodes containing endochrome and about thrice as long as broad, coated externally by a thin stratum of minute cellules, from which radiate to all sides numerous, dichotomous, moniliform, horizontal filaments, whose apices, strongly soldered together, unite to form the periphery. The *substance* is firmly cartilaginous, rigid when dry. *Colour* a very dark-red brown. *Conceptacles* spherical, sessile on the ramuli.

Dr. Ruprecht's *Acanthocladia hamulosa* is in all respects identical with my *Gigartina muricata*, first described in the Botany of Beechey's Voyage. His *A. muricata* is more slender and less regularly muricated than most of my specimens, but I do not consider it specifically different. I have not seen any specimens of Agardh's *E. vernicata*.

Plate XXVII. B. *Fig.* 1. Tuft of Endocladia *muricata*, the *natural* size. *Fig.* 2, part of a frond with conceptacles ; *fig.* 3, apex of one of the muricated branches ; *fig.* 4, transverse section of the stem ; *fig.* 5, longitudinal section of the same ; *fig.* 6, vertical section of a conceptacle ; the latter figures more or less highly *magnified*.

XIII. GLOIOPELTIS. *J. Ag.*

"*Frond* cylindrical, tubular, lubricous, cartilaginous, dichotomous and branched, composed of two strata ; a monosiphonous, articulated, flexuous, axial filament runs through the empty tube, and throws off at alternate sides, di-tri-chotomous, corymboso-fastigiate, moniliform, horizontal filaments, which (united by a loose gelatine), form the peripheric stratum. *Conceptacles* hemispherical, containing within a pericarp finally opening by a pore, numerous laxly aggregated *nucleoli* separated by barren filaments running from an axial placenta to the pericarp. *Tetraspores* oblong, cruciate, scattered among the moniliform, peripheric filaments." *J. Ag.*

Two species, with neither of which am I acquainted, constitute the present genus ; one of them (the *Fucus tenax*, *Turn. Hist. t.* 125) a native of the Chinese seas, and used extensively in the arts of China and Japan ; the other a minute plant from the Northern Pacific, which I give below as being probably a native of Russian America.

1. Gloiopeltis *furcata*, J. Ag. ; "dwarf, tufted ; fronds rising from a minute crust, erect, filiform, attenuated at both ends, simple or sparingly forked." *J. Ag. Sp. Alg.* 2, *p.* 235. *Dumontia furcata*, *Post. and Rupr. Illustr. p.* 19. *Kütz. Sp. Alg. p.* 719.

Hab. In the Northern Pacific, *Mertens*.

"*Crust* minute, tuberculose, adhering to stones. From this crust spring the *fronds*, which are half an inch high, rarely an inch, more or less crowded, terete, attenuate at each end, simple or twice or thrice forked, with patent branches. *Colour* purplish. *Substance* cartilaginous."

XIV. CRYPTONEMIA. *J. Ag.*

Frond flat, rigidly membranous, sub-caulescent, proliferous or branched, composed of three strata of cells ; the medullary of elongated, branched, densely interwoven filaments ; the intermediate of roundish cells, towards the surface passing into the minute cells of the cortical layer. *Nuclei* (favellæ) immersed, prominent to one surface, simple, consisting of numerous roundish spores, contained within a hyaline membrane, at length discharged through a superficial pore. *Tetraspores* collected into roundish, wart-like sori, lodged either in special leaflets or beneath the apices of the leaves, oblong, cruciate.

Plants with the rigid substance and the external habit of *Phyllophora*, from which they are well distinguished both by the different structure of the frond and the simplicity of the nucleus. This latter character, combined with the different disposition of the tetraspores and the rigid substance, distinguishes them from *Kallymenia* to which the internal structure of the frond allies them. Six species are described, four of which are peculiar to the southern shores of Europe, and two to the warmer regions of America. One of these last is described below.

1. Cryptonemia *crenulata*, J. Ag. ; stipes short, soon expanding into a broadly cuneate, bifid or repeatedly forked frond, eroso-denticulate (or rarely sub-entire) at the margin, and proliferous with similarly forked, broadly proliferous frondlets. *J. Ag. Sp. Alg.* 2, *p.* 225. *Phyllophora crenulata*, *J. Ag. Kütz. Sp. Alg. p.* 791.

Hab. Common at Key West, Florida, *W. H. H.* (v. v.)

Fronds densely tufted, about six inches long, with a short cylindrical stipes as thick as a crow's quill and half an inch long, which rapidly expands into the cuneate base of a membranous, simple or forked lamina. This lamina is one to two inches wide below the first fork ; its segments half an inch wide, linear or wedge-shaped, with acute axils, obtuse or truncate apices, and generally an eroso-denticu-

late and minutely curled margin. Sometimes the margin is quite entire and flat. The primary lamina is frequently proliferous from the summit or disc of its lobes with similar secondary fronds ; and these in large specimens bear tertiary ones, the whole resulting in a broadly fan-shaped general outline. *Colour* a clear, deep lake-red, changing to greenish-white in fresh water. *Substance* rigidly membranaceous. It does not adhere to paper. The medullary stratum is formed of densely interwoven filaments ; outside which are several rows of coloured, polygonal cells, the innermost being large, the rest successively smaller ; the superficial ones very minute.

XV. CHYLOCLADIA. *Grev.—J. Ag.* ref.

Frond terete or sub-compressed, (rarely nodoso-articulate,) alternately or pinnately-decompound, tubular ; the tube empty, or traversed by a few slender, longitudinal filaments ; the periphery formed of several rows of roundish-angular cells, successively smaller to the surface. *Conceptacles* external, conical or apiculate, at length pierced by a pore, containing a *nucleus* enclosed in a hyaline mucous envelope, surrounded by a net-work of anastomosing filaments ; the *spores* "originating in the cells of filaments radiating from a placenta, at length" numerous, massed together. *Tetraspores* triangularly parted, dispersed among the superficial cells of the branches.

I adopt this genus as now, by Prof. J. Agardh, restricted to the *Fucus clavellosus*, Turn. Hist. t. 30, and its allies. Among these latter, however, I place the *F. articulatus*, Lightf. notwithstanding its difference of habit, because, as correctly pointed out by Dr. Greville, (Alg. Brit. p. 114) the structure of its conceptacle, both externally and internally, is similar to that of *F. clavellosus*. I have not verified the mode of development of the spores as given in the generic character on Prof. Agardh's authority ; the specimens which I have at hand exhibiting only the nucleus as it eventually becomes, namely, a cluster of disorderly spores contained within a mucous integument, closely resembling a "favella."

1. Chylocladia *Baileyana ;* fronds tubular, cylindrical, densely tufted, short, irregularly much branched ; branches (mostly arching) divaricated, secund or scattered, their lesser divisions mostly secund, and furnished with a few secund, spindle-shaped ramuli tapering to the base and apex. *C. divaricata, Harv. MSS. (not of J. Ag.)* (Tab. XX. C. Fig. 1.) *β filiformis ;* very slender, elongate, with longer and less arching branches. (Tab. XX. C. Fig. 2) *γ.* ? valida ; frond robust, firm, sometimes with arching, unilateral ramification ; sometimes sub-alternately pinnate.

Hab. Dredged in four or five fathom water. Vars. α and β, Peconic Bay, abundantly, *Prof. Bailey and W. H. H.* Narragansett Pier, *Mr. Olney.* Providence, *Prof. Bailey.* Weymouth Pier, Quincey, Massachusetts, *Dr. Durkee.* γ, abundant in Charleston Harbour, S. Carolina, *Prof. Gibbes and W. H. H.* (v. v.)

Tufts globose, two to three inches in diameter, dense and often intricate, sub-fastigiate. *Fronds* in vars. α and β as thick as hog's bristle, branched from the base in a very irregular manner, all the divisions standing at considerable angles and much divaricated. In var. α all the branches are strongly arched back, or revolute, destitute of branchlets on the concave side, and this ramification is repeated several times. In β the tendency to secund ramification is nearly as great as in α, but the branches are straighter and more attenuate. In γ, which may possibly be a different species, the frond is as thick as sparrow's quill, of firmer substance, and the ramification partakes sometimes of the character of α, sometimes of β. *Conceptacles* unknown to me. *Tetraspores* immersed in the smaller ramuli. *Colour* a pinky red, becoming darker and somewhat brownish when dried. In drying, it adheres closely to paper.

I formerly distributed this plant under the MS. name *C. divaricata*, a name which must be laid aside if the *Fucus divaricatus*, R. Br. be correctly referred by Prof. Agardh to this genus. Nor am I certain whether the specific name now imposed be more than provisional, as future observation may show our plant to be identical with the *Ch. uncinata* of the Mediterranean, a point which I have not at present the means of determining satisfactorily.

However this may be, our vars. α and β appear to form a well marked species. Perhaps var. γ should be separated; being much more robust, more readily recovering its form after having been dried, and when pinnulated, not unlike some states of *Ch. clavellosa.*

Tab. XX. C. Fig. 1. Chylocladia *Baileyana*, var. α; fig. 2, var. β; both of the *natural* size. Fig. 3, part of a branch of var. γ, with ramuli, containing tetraspores; *magnified.* Fig. 4, cross section of a branch of var. γ; and fig. 5, portion of the same, variously *magnified.*

2. Chylocladia *rosea*, Harv.; fronds sub-stipitate, distichously-pinnate or bi-pinnate; pinnæ and pinnules elliptic oblong, obtuse or sub-acute, much constricted at the base, compressed, opposite. *Harv. in Phyc. Brit. t.* 301 *and t.* 358 *A.*

Hab. On small Algæ in tide-pools, rare. Newport, Rhode Island, *Mr. George Hunt and Mr. S. T. Olney.* β. *Portsmouth, New Hampshire, Dr. Durkee.* (v. s. in Herb. T. C. D.)

Fronds densely tufted, one or two inches high, one to two lines broad, compressed, twice or thrice pinnate; the pinnæ distichous, opposite or rarely alternate, or by suppression unilateral, oblong-linear, much constricted at the base, obtuse, the lowest longest, the rest gradually smaller; pinnules elliptical, very obtuse. *Colour,*

a beautiful rosy red or purplish lake. *Substance* delicately membranaceous. It closely adheres to paper in drying.

Dr. Durkee's specimen, noticed above, is irregularly branched, the primary stems filiform and straggling; the secondary either pinnated or furnished at one side only with pinnules. I have seen British specimens similar to this in ramification.

XVI. CHRYSYMENIA, *J. Ag.* ref.

Frond subterete, compressed, or flat, tubular or solid, branched; the tube sometimes nearly empty or with a few percurrent longitudinal filaments, sometimes filled with interlaced filaments; peripheric stratum composed internally of large, roundish-angular, inflated cells, externally of minute, coloured, vertically seriated cellules. *Conceptacles* half immersed in the frond, hemispherical or with a prominent orifice, containing a simple *nucleus (favella)* fixed to a basal placenta, surrounded by anastomosing filaments, and consisting of very numerous, densely-packed minute spores enclosed within a membrane. *Tetraspores* cruciate, scattered among the superficial cells of the frond.

This genus, as at present constituted, includes plants of very different habit, and in some respects of different structure. In the genuine species (sections *Halichrysis and Chrysymenia*, J. Ag.) the frond is dichotomous or pinnated, evidently tubular, but having the tube sometimes compressed, sometimes inflated, nearly empty, or traversed by a very few slender filaments, which are often obsolete in the full-grown plant. In our section *Cryptarachne*, the frond, which is either flat or cylindrical, is more or less densely filled with anastomosing, branched, often closely interwoven filaments, but the external habit of the species is not very dissimilar to that of the former sections. Finally, in the section *Botryocladia*, J. Ag. a much branched, filiform, solid stem bears inflated ramuli, having the proper structure of the genus. The species of this section depart widely in external habit from the rest; and yet they are perhaps nearer in affinity to the typical species than are those of our section *Cryptarachne*.

Sect. 1. Chrysymenia (*Halichrysis and Chrysymenia*, J. Ag.); *frond compressed or inflated, evidently tubular; the tube empty or nearly so.*

1. Chrysymenia *Enteromorpha;* frond saccate, fusiform, somewhat compressed, delicately membranaceous, proliferously-decompound; secondary fronds and their

tertiaries strongly constricted at the base, tapering to the apex, springing without order from all sides, and from the apex, of the primary frond.

Hab. Key West, Florida, rare, *W. H. H.* (v. v.)

The full-grown, compound frond is eight or ten inches long or more, and nearly as much in the expansion of the branches. It originates in a simple, saccate, oblong frond, one to two inches long and about half an inch in diameter, rising from a short, cartilaginous stipes, one to two lines long. This primary sac throws out very irregularly, from its sides and apex, numerous secondary sacs of equal breadth, but generally of greater length, three to four inches long, strongly constricted at the base, or rather minutely stipitate, linear-oblong or somewhat obovate and obtuse. These sacs of secondary order, in their turn give off tertiary sacs, which are generally a quarter inch in diameter, more fusiform than the secondary ones, tapering to the apex, and bearing other smaller, more tapering, irregularly set, sac-like ramuli. In large specimens these latter bear others, and thus the frond continues to become compound by successive proliferous repetitions of sac-like branches. *Substance* delicately membranaceous, somewhat gelatinous within. The walls are composed of an inner row of large, empty cells, defended externally by two or three rows of minute, polygonal, coloured cellules. *Tetraspores* abundantly scattered through the cells of the outer coating. *Colour*, a delicate, rosy-red. In drying, it closely adheres to paper.

This plant so much resembles some varieties of *Halymenia ligulata*, that I had at first mistaken it for one of the forms of that sportive species, nor was it till a transverse section assured me that it belonged to a different genus, that I discovered my error. On more closely examining the specimens, an external character is readily found in the ramification ; the present species, though it eventually becomes excessively compound, being constituted of numerous series of perfectly *simple* frondlets growing one on the other, and never, that I have seen, *forking*, as do the ramenta of *Hal. ligulata*. Under the microscope, the different structure of the two plants is very obvious.

2. Chrysymenia *halymenioides ;* frond compressed, broadly linear, cuneate at the base, dichotomous, fastigiate ; the axils rounded, and the laciniæ divaricated, very obtuse ; conceptacles hemispherical, prominent, scattered. (Tab. XX. A.)

Hab. Thrown up from deep water. Key West, very rare, *W. H. H.*, *Dr. Blodgett.* (v. v.)

Root scutate. *Fronds* one or more from the same base, three to four inches long, a quarter to half an inch wide in the widest part, rising from a slender, filiform base, rapidly widening upwards to the first fork ; thence broadly linear and repeatedly and pretty regularly dichotomous. Sometimes from a wounded part a dense

tuft of dichotomous branches spring, making the habit very bushy. The axils are singularly rounded, the laciniæ very widely spreading, and the apices remarkably obtuse. The frond is tubular, but strongly compressed and almost flattened. Its walls are thin ; the inner stratum composed of polygonal, inflated, empty cells of large size ; the outer of very minute, coloured cellules, set in densely packed, vertical filaments. *Conceptacles* plentifully scattered over all the lower laciniæ, between hemispherical and conical, prominent. *Tetraspores* dispersed through the superficial cells of distinct plants. *Colour*, a clear, rosy red, becoming brownish in drying. *Substance* soft and lubricous, full of juice. It adheres closely to paper in drying.

This is nearly related to the Mediterranean *C. dichotoma*, J. Ag. ; but appears, judging by the description, to differ in some respects. It has much of the external aspect of some varieties of *Halymenia ligulata*, whence our specific name.

Plate XX. A. *Fig.* 1. Chrysymenia *halymenioides ;* the *natural* size. *Fig.* 2, transverse section of a lacinia, cutting through three *conceptacles ; fig.* 3, portion of the surface, viewed vertically ; *fig.* 4, section of the wall of the frond with immersed tetraspores ; *fig.* 5, tetraspores ; *fig.* 6, section of a *conceptacle ; fig.* 7, nucleus from the same ; *fig.* 8, spores ; the latter figures more or less highly *magnified.*

Sect. 2. Cryptarachne ; *frond flat, compressed or cylindrical, sub-solid ; the medullary stratum composed of interlaced, anastomosing, branching filaments.*

3. Chrysymenia (Cryptarachne) *Agardhii ;* frond gelatino-membranaceous, flat, dichotomously cleft, laciniæ cuneate at the base, tapering to the extremity, undulate, unequally eroso-dentate at the margin ; the marginal processes sometimes lengthening into linear lobules ; conceptacles acuminate, scattered over the laciniæ. (Tab. XXX. A.)

Hab. Thrown up from deep water, Key West ; rare, *W. H. H.* (v. v.)

Frond six or eight inches long, as much or more in expansion of the laciniæ, having a wide, cuneate base, one to two inches long and an inch and half broad, at once dividing into several laciniæ, in a somewhat palmate order. These laciniæ are simple or forked, or palmatifid, cuneate at the base, about an inch wide at the widest part, tapering to both ends, undulate, with the margin rarely quite entire, more commonly eroso-denticulate. Marginal teeth horizontally patent, very unequal in size, sometimes mere processes a line or two in length, sometimes half an inch long and a line broad. *Conceptacles* scattered over the laciniæ, rather prominent, conical, with the orifice very prominent and slightly oblique. The medullary stratum consists of a dense web of branching and anastomosing filaments ; the intermediate of several rows of empty cells, of which the inner are very large, the rest successively smaller ; the cortical of very minute, coloured, seriated cells, in two or three vertical rows. *Colour*, a pale rose-red, fading and becoming

brownish in drying. *Substance* very gelatinous. In drying, the frond shrinks and adheres very strongly to paper.

The name is bestowed in honour of my friend Prof. J. G. Agardh, to whose opinion (as expressed in a private letter) I yield in retaining this species and its allies for the present in *Chrysymenia*. They differ, as already stated, from the genuine species in having a far more obvious plexus of filaments occupying the centre of the frond.

Plate XXX. A. Chrysymenia ? *Agardhii ;* the *natural* size. *Fig.* 2, a section of the frond, and *fig.* 3, a small portion of the same ; *fig.* 4, section of a conceptacle ; all highly *magnified.*

4. Chrysymenia (Cryptarachne) *ramosissima ;* frond compressed below, terete above, distichously much branched ; branches patent, with rounded axils, tapering to the base and apex, successively narrower and repeatedly compound, the lesser ones margined with a few spines ; ramuli either filiform, or, when fertile, fusiform, acute and irregularly spinulose ; conceptacles depressed, or sunk in the fusiform ramuli, sphæroidal. (Tab. XXX. B.)

Hab. Thrown up from deep water ; rare. Key West, *W. H. H.* (v. v.)

Frond eight to twelve inches long and six to eight inches in the expansion of the branches. Main stem sub-simple, rising from a cartilaginous stipe as thick as a crowquill, soon widening to half an inch in breadth, compressed, tapering gradually to the summit, more or less cylindrical above. This principal stem is furnished throughout, at short distances, with lateral, very patent, distichous branches, issuing at very obtuse angles, tapering to the base and apex like the main stem ; of various lengths, short and long intermixed without order ; the larger ones repeatedly compound in a similar manner. In some specimens the secondary and tertiary branches are very closely set, scarcely more than a line or two apart ; in others they are much more distant. The fertile and barren specimens are also very unlike ; the latter are much more branched, the branches narrower and more finely divided, and the ramuli very slender and abundant ; the former (like that in our figure) have most of the ramuli swollen, broadly fusiform, acute, and sub-dentate. *Conceptacles* lodged in the swollen ramuli, depressed. *Colour*, when growing, a fine, clear rosy red, becoming brownish in drying. *Substance* membranaceous, filled with loose gelatine, which is expelled under pressure, and apt to stain the paper on which the specimen is displayed.

Plate XXX. B. Chrysymenia *ramosissima*, lower part of a fertile specimen ; the *natural* size. *Fig.* 2, a ramulus containing conceptacles ; *fig.* 3, vertical section through a conceptacle ; *fig.* 4, longitudinal section of a branch ; *fig.* 5, filaments of the medullary stratum ; *fig.* 6, transverse section of a branch ; the latter figures variously *magnified.*

5. Chrysymenia ? (Cryptarachne ?) *acanthoclada ;* stem somewhat distended, (laxly cellular with a dense fibro-cellular axis) divaricately much branched, irregularly decompound ; branches distichous, slender, much attenuated, widely spreading, zig-zag, alternately decompound, aculeate with short, sub-distichous, spine-like, subulate, acute, divaricated ramuli. (Tab. XXV.)

Hab. Thrown up from deep water. Key West, very rare, *W. H. H.* (v. v.)

Root a spreading disc. *Frond* solitary (?) rising with a stipes half an inch, then branching, either forked, trifurcate or laterally decompound, the main branches incrassated, two to three lines in diameter, simple or forked, set with numerous lateral branches, which are much more slender, alternately-decompound, and very much attenuated at the points, sometimes drawn out almost into setaceous cirrhi. All parts of the frond are distichous and divaricate ; the secondary branches strikingly zig-zag or bent alternately from side to side. *Ramuli* thorn-like, one to two lines long, acute, patent. *Colour*, a deep lake-red when fresh, brownish when dry. *Substance* between cartilaginous and gelatinous. It shrinks much and closely adheres to paper in drying. *Fruit* unknown.

The fruit of this remarkable plant being unknown, its genus is still doubtful, but it seems to me to have many points in common with our *Ch. ramosissima*, and I do not think it placed far from its affinities in the present genus. The perfectly distichous branching and gelatinous substance are worthy of attention in determining its relationship.

Plate XXV. Chrysymenia ? *acanthoclada ;* the *natural* size. Fig. 2, transverse section of a branch ; *magnified.*

Sect. 3. Botryocladia, J. Ag. ; *stem filiform, solid, branching, beset with inflated, pear-shaped ramuli.*

6. Chrysymenia *uvaria*, J. Ag. ; frond cylindrical, solid, dichotomous or irregularly much branched ; branches filiform, beset with scattered or imbricated, inflated, obovate ramuli ; conceptacles depressed, hemispheroidal. *J. Ag. Sp. Alg.* 2, *p.* 214. *Gastroclonium uvaria*, *Kütz. Sp. Alg. p.* 865. (Tab. XX. B.)

Hab. Thrown up from deep water. Key West, common, *W. H. H.* (26), (v. v.)

Fronds tufted, six to twelve inches long or more, the larger specimens as thick as crow-quills, the smaller as thick as sparrow quills, cylindrical, solid, firmly cartilaginous, rigid, irregularly much branched, the lower branches sub-dichotomous. Sometimes the upper branches are bushy with a profusion of rod-like or tendril-like lesser branches. The stems and larger branches of old specimens are generally bare, or furnished with a few imperfectly developed ramuli, but all the younger branches, and the whole frond in young specimens, are thickly covered with quadrifarious, obovate, inflated, glossy ramuli. On these ramuli the depressed *conceptacles*

are borne. The *colour* of the stem and branches is dark red; of the ramuli a brilliant lake. *Substance* of the ramuli succulent and tender.

This very beautiful plant is a native also of the Mediterranean Sea and of the shores of Brazil. It strikingly resembles *Lomentaria ovalis* in ramification, but has a different structure and fructification.

Plate XX. B. Fig. 1. Chrysymenia *uvaria ;* the *natural* size. *Fig.* 2, a ramulus with *conceptacles ; fig.* 3, section of a conceptacle ; both *magnified.*

XVII. HALYMENIA. *Ag.*

Frond cylindrical, compressed or flat, gelatinoso-membranaceous or fleshy, dichotomous or pinnated, consisting of a thin, double membrane, separated by a few internal, laxly set, articulated, branching filaments; membrane composed internally of roundish-angular, empty cells, externally of minute, coloured cellules. *Nuclei* (favellæ) immersed in the frond, suspended beneath the membranous wall, simple, containing numerous minute, densely packed spores, enclosed within a hyaline envelope. *Tetraspores* roundish, cruciate, immersed in the surface cellules, dispersed.

Rose-red Algæ of a very delicate, membranaceo-gelatinous substance, cylindrical or flattened, formed of a membranous coating, enclosing a thin watery gelatine, through which a few articulated, branching and anastomosing filaments are dispersed. The branching is most frequently dichotomous, rarely pinnated ; often proliferous, new frondlets springing irregularly from the sides of the old, especially from wounded places. In fertile specimens the *favellæ* are generally equally dispersed in great numbers through every part of the plant. Several species from various parts of the world have been described, of which I can as yet claim but two as North American : viz.

1. Halymenia *ligulata*, Ag.; frond gelatinoso-membranaceous, compressed or flattish, linear and dichotomous or cuneately expanded and sub-palmate, often proliferous from the disc and margin. *J. Ag. Sp. Alg.* 2, *p.* 201. *Harv. Phyc. Brit. t.* 112. *Halarachnion ligulatum, Kütz. Sp. Alg. p.* 721. *Ulva ligulata, E. Bot. t.* 420. *U. rubra, E. Bot. t.* 1627.

Hab. Thrown up from deep water. Key West, a single specimen only. *W. H. H.* (v. v.)

The only American specimen of this variable plant that I have yet seen is four

inches long, about five inches in the spread of the laciniæ, flabelliform, sub-fastigiate, repeatedly and pretty regularly dichotomous, the larger divisions a third of an inch wide, the upper gradually narrower, and the ultimate ones a line or less in width ; apices acute. *Substance*, membranaceo-gelatinous. *Colour*, a fine, clear, pinky red. It closely adheres to paper in drying.

2. Halymenia *Floresia*, Ag. ; frond gelatino-membranaceous, flat, stipitate, elongate, pinnately-decompound ; pinnæ and pinnules linear, acuminate, acute, patent, entire or serrato-ciliate. *J. Ag. Sp. Alg.* 2, *p.* 205. *Kütz. Sp. Alg. p.* 716. *Fucus Floresius*, *Turn. Hist. t.* 256.

Hab. Thrown up from deep water. Key West, rare, *W. H. H.* (66), *Dr. Blodgett.* (v. v.)

Root a small disc. *Fronds* solitary or slightly tufted, six to eight inches long, and as much in the expansion of the laciniæ, somewhat ovate in outline, flat, and very thin, decompound-pinnatifid. Sometimes the main frond (or rachis) is two or three inches wide, with the margin cut into very densely crowded, bi-pinnatifid lobes, half an inch wide and two or three inches long ; sometimes the frond is much more deeply laciniated, the rachis and principal laciniæ not more than half an inch wide ; the laciniæ once, twice, or thrice compounded ; the secondary ones one or two lines wide, and margined with subulate, tooth-like processes. *Axils* rounded ; *apices* all acute and attenuated. *Colour*, a beautiful rosy-red. *Substance* delicately gelatino-membranaceous. In drying it adheres most closely to paper.

An extremely handsome plant. The Key West specimens, here described, closely agree with the Mediterranean ones in Herb. T. C. D. Some are very broad, others narrow.

XVIII. HALOSACCION. *Kütz.*

Frond cylindrical or obovate, simple or proliferously branched, hollow, the walls formed of two strata of cells ; the inner stratum of two or more rows of roundish-angular cells, the outer of oblong, vertically-seriated, coloured cellules. *Conceptacles* (unknown). *Tetraspores* cruciate, dispersed among the cortical cells.

Until the conceptacular fruit of this genus shall be discovered, its proper position must be considered doubtful. It is almost entirely constituted of Algæ from the higher latitudes of the Atlantic and Pacific, and includes two distinct groups, each characterised by differences of outward form, and by habitat. The Pacific species

are all obovate, and unbranched ; the Atlantic cylindrical, proliferously-ramulose. The substance is rather rigid, and the colour purplish or brownish red.

Sect. 1. Halosaccion ; *frond simple, obovate.*

1. Halosaccion *Hydrophora*, J. Ag. ; frond rigidly membranaceous, obovate-oval, turgid, attenuate at the base into a short stipes. *J. Ag. Sp. Alg.* 2, *p.* 358. *Dumontia Hydrophora*, *Kütz. Sp. Alg. p.* 749. *Fucus saccatus*, *Turn. Hist. t.* 241 ?

Hab. Nootka Sound, *Mr. Menzies.* Puget's Sound, *Captain Wilkes.* (v. s.)

Fronds tufted, three inches long or more, three quarters of an inch wide, very obtuse, oblong or sub-obovate, quite simple, contracted rather suddenly at the base into a very short stipes. *Substance* thickish, like that of parchment, rigid. *Colour* a dull livid purple, passing into green. In drying it does not adhere to paper.

2. Halosaccion *fucicola*, Post. and Rupr. ; frond simple, membranaceous, obovate-oblong, gradually attenuated at the base into a stipes. *J. Ag. Sp. Alg.* 2, *p.* 358. *Dumontia fucicola*, *Post. and Rupr. Kütz. Sp. Alg. p.* 720.

Hab. On *Fucus vesiculosus* at Sitcha, *Lütke.* On *Laurenciæ* at Monterey, *Dr. Coulter.* (v. s. in Herb. T. C. D.)

Fronds resembling the last species, but thinner and softer in texture, and brighter in colour, purple.

Sect. 2. Halocoelia, J. Ag. ; *frond cylindrical, elongate, beset with similar proliferous ramuli.*

3. Halosaccion *ramentaceum*, J. Ag. ; frond cylindrical, much attenuated at the base, simple or irregularly branched, more or less densely beset with lateral, scattered or crowded, simple or forked, tubular ramenta. *J. Ag. Sp. Alg.* 2, *p.* 358. *Dumontia sobolifera*, *Kütz. Sp. Alg. p.* 749. *Fucus ramentaceus*, *Linn.—Turn. Hist. t.* 149. (Tab. XXIX. A.)

Hab. Greenland, *Agardh.* Newfoundland, *Despreaux.* Arctic Coast, *Seeman.* Halifax, *W. H. H.* Rye Beach, New Hampshire, *Miss Frothingham.* (v. v.)

Fronds very densely tufted, ten to fourteen inches long, cylindrical, one to two lines wide at the widest part, much attenuated to the base, and more or less tapering to the apex, sometimes quite simple, sometimes dividing an inch or two above the base into several long simple branches. The frond is rarely naked, usually it is

beset, in its upper half, with quasi-proliferous ramenta, given off without order and often very densely fascicled, one to two inches long, filiform, simple or slightly ramulose, sometimes forked, and very often twisted or otherwise distorted, all tapering to the base, and in a less degree to the apex. *Colour*, a dark lurid purple, paler in the ramenta. *Substance* rigidly membranaceous or sub-coriaceous. In drying under pressure, it imperfectly adheres to paper.

A most variable plant in the number and disposition of its ramenta, but easily recognised after it has once been seen.

Plate XXIX. A. *Fig.* 1, Halosaccion *ramentaceum ;* the *natural* size. *Fig.* 2, transverse section of the frond ; *magnified*. *Fig.* 3, a small part of the same, more highly *magnified*.

XIX. FURCELLARIA. *Lamour.*

Frond terete, dichotomous, fastigiate, solid, composed of three strata of cells ; the medullary stratum of densely interwoven, longitudinal, elongate filaments ; the intermediate of large, roundish cells ; the cortical of small cellules strung together in moniliform, vertical filaments. *Fruit* of both kinds contained in the swollen, pod-like apices of the branches. *Nuclei* (*favellæ*) simple, immersed, formed from some of the cells of the intermediate stratum, numerous in each pod, at length often confluent, each containing many large angular spores in a cluster. *Tetraspores* immersed within the cortical layer, formed in its filaments, large, pear-shaped, transversely zoned.

Very similar in external aspect, and even in the internal structure of the frond, to *Polyides rotundus*, a plant from which it differs so remarkably in fructification, that in a classification founded on differences of fruit, we are compelled to place these genera at opposite ends of our arrangement. The only known species, described below, is common to a wide extent of the Northern Atlantic Ocean.

1. Furcellaria *fastigiata*, *Lyngb.—J. Ag. Sp. Alg.* 2, *p.* 196. *Kütz. Sp. Alg. p.* 749. *Harv. Phyc. Brit. t.* 94 *and t.* 358. *Fucus lumbricalis*, *Turn. Hist. t.* 6. *E. Bot. t.* 846.

Hab. Newfoundland, *Agardh.* (v. v.)

Root, a mat of creeping fibres. *Fronds* 4—8 inches high, nearly a line in diameter, tufted, cylindrical, repeatedly dichotomous, the branches of equal height, the axils and apices acute. When in fruit, the ends of the branches, for an inch or more,

swell into spindle-shaped, pod-like receptacles, which, when mature, drop off, leaving the branches truncated. In these receptacles either *nuclei* or *tetraspores* are lodged ; the former sunk among the cells of the intermediate layer, from some of which they are evolved ; the latter lying among those of the outer stratum. *Colour* dark red-brown, blackish when dry. *Substance* fleshy, sub-coriaceous when dry.

XX. ACROTYLUS. *J. Ag.*

Frond terete or compressed, cartilaginous, simple or dichotomous, consisting of two strata ; the medullary stratum of slender, elongate, branching and anastomosing longitudinal filaments ; the cortical narrow, of minute, roundish, densely packed, coloured cellules, vertically seriated. *Favellæ* (known only in one species) formed in wart-like swellings round the apices, many together, containing within a hyaline periderm numerous angular spores. *Tetraspores* (known only in one species) formed in definitely circumscribed spot-like sori (*nemathecia*) situated below the apices of the segments, elongate, surrounded by slender filaments, zonate.

A small genus founded by Prof. J. Agardh on an East Indian and an Australian species, to the former of which the plant now to be described is closely related. *A. prismaticus*, J. Ag. is described as being prismatically three-or-four-angled, a character which it certainly possesses when dry ; but I am of opinion that in the recent state it is cylindrical, like our *A. clavatus*, which, if dried without pressure, also collapses in a prismatic-angular manner, and equally refuses to recover its shape on being moistened after having being dried.

1. Acrotylus *clavatus ;* frond, from a filiform stipe, club-shaped, terete, obtuse, simple or forked (the branches being then club-shaped,) proliferous from the apex.

Hab. Thrown up from deep water, Key West, *W. H. H.* (63). (v. v.)

Root a small disc. *Stipes* a quarter to half an inch high, as thick as hog's bristle, filiform, ending in an incrassated collar. *Frond* springing from the centre of the collar, about two inches long, club-shaped, tapering to the base, incrassated and obtuse at the apex, terete, prismatically shrinking when dried without pressure, and not recovering its form on re-moistening, simple or forked. *Colour*, a very dark purplish-red. *Substance* firmly cartilaginous. *Structure* very dense. *Fruit* unknown.

Of this curious plant I collected a very few specimens at Key West, in February,

after strong South Westerly gales. They are apparently immature, but unquestionably congenerous with *A. prismaticus*, with which they agree in structure and substance. Possibly mature specimens may be more compound.

XXI. PRIONITIS. *J. Ag.*

Frond compressed or flat, linear, dichotomous or pinnate, proliferous or glandular on the disc or margin, composed of three strata ; the medullary stratum very broad, of densely interwoven, slender filaments; the intermediate of roundish cells, smaller towards the surface ; the cortical of minute, coloured, vertically seriated cellules. *Nuclei* (*favellæ*) immersed either in the frond or its marginal processes, simple, containing roundish spores within a gelatinous pellicle, at length discharged through a superficial pore. *Tetraspores* oblong, cruciate, dispersed among the cells of the cortical layer.

Rather coarse Algæ, of a thick, coriaceous or rigid substance and very dense texture, linear, nerveless, pinnate or dichotomous, often much branched, frequently margined with minute glands, which afterwards grow out into lobules. Most turn very dark in drying.

The species here brought together have been formerly arranged with *Sphærococcus*, *Gelidium* or *Grateloupia ;* and are nearly related to the latter genus, differing chiefly in the more compound structure of the frond. Eight species are enumerated by Agardh, all natives of the Pacific Ocean, three being found to the north, and five to the south of the equator.

1. Prionitis *lanceolata*, Harv. ; frond plano-compressed, linear, alternately or irregularly branched ; branches ligulate, attenuate at the base and apex, naked or pinnate ; pinnæ lanceolate, distichous, mostly opposite ; tetraspores cruciate, immersed in the pinnules. *Prionitis ligulata*, *J. Ag. Sp. Alg. vol.* 2, *p.* 189. *Gelidium lanceolatum*, *Harv. in Bot. Beechey*, *p.* 164. (Tab. XXVII. A.) *β angusta ;* much more slender, forked, with few and nearly naked branches.

Hab. Prince William's Sound and Nootka, *Mr. Menzies*, 1787. California, *Douglas ! Dr. Coulter ! β* St. Francisco, *Capt. Pike.* (v. s. in Herb. T. C. D.)

Root discoid. *Fronds* tufted, twelve or fourteen inches long, one to two lines wide, much compressed or nearly flat, linear, tapering to the base and apex, alternately branched or pinnate. The primary branches are several inches long, quite simple, and either naked or distichously pinnulate. *Pinnules* about half an inch

long, lanceolate, not very acute ; sometimes longer and then frequently pinnellated near the end. Along the margin of the *naked* branches or pinnæ, minute gland-like prominences occur at intervals, which I take to be the commencement of pinnules that are often arrested in growth. Here and there a branch occurs, constricted in the middle as well as at the extremities. Many of the branches bear wart-like excrescences. *Tetraspores* are abundantly found in the lesser pinnæ, lying among the cortical cells. *Colour*, a dull brown-red, dark when dry. *Substance* rigid, between coriaceous and horny. It does not adhere to paper.

β, which I have from Capt. Pike, is very much more slender, with very few branches and scarcely any pinnules.

The specimens found by Mr. Menzies are of smaller size and more regularly pinnated than many of Douglas's; but some of Dr. Coulter's are equally well furnished, and thus the two extreme forms are brought together.

Plate XXVII. A. *Fig.* 1. Prionitis *lanceolata ;* the *natural* size. *Fig.* 2, transverse section of the frond, showing the cellular structure ; *fig.* 3, small part of the same, showing the peripheric stratum with immersed tetraspores, and the intermediate stratum ; *fig.* 4, tetraspores ; all *magnified.*

2. Prionitis *jubata*, J. Ag. ; "frond flat, pinnately decompound, pinnæ linear, tapering at each end, sparingly denticulate at the margin, pinnated above, the pinnæ lanceolate-linear." *J. Ag. Sp. Alg.* 2, *p.* 190. *Gelidium crassifolium*, *Post. and Rupr. MSS.* (*not of Grev.*)

Hab. Floating in the sea, between Asia and Russian America, *Lütke.*

Three or four inches long, or more, sub-stipitate, the primary lamina narrower and thickened. From the upper part of this spring four or five primary pinnæ nearly in palmate order, an inch and half long, much attenuated at the base, two or three lines broad beyond the middle, tapering upwards to the truncate apex. Secondary pinnæ chiefly towards the apices of the primary, much narrower, scarcely a line broad, naked or very sparingly denticulate, pinnate beyond the middle, pinnules here and there aggregated, alternate or secund, sub-acute. *Colour* brownish. *Substance* coriaceous. *J. Ag.*

XXII. GRATELOUPIA. *Ag.*

Frond compressed or flat, carnoso-membranaceous, dichotomous or more frequently pinnate, consisting of two strata of cells ; the medullary of articulated filaments densely interwoven and anastomosing, the cortical of short, moniliform, vertical, closely set filaments. *Nuclei* (*favellæ*) immersed beneath the cortical layer of either

surface, simple, containing, within a gelatinous hyaline pellicle, numerous roundish-angular spores, which are at length discharged through a superficial pore. *Tetraspores* immersed in the cortical layer, scattered, cruciate.

Fronds dark brownish red or purple, sometimes livid, changing to green in decay, strongly compressed or flat, narrow-linear or rarely cuneato-lanceolate, very generally pinnately decompound, rarely dichotomous ; of a compact structure, and soft, membranaceo-gelatinous or carnoso-coriaceous substance, very tough when recent, lubricous, and difficult to detach from the rock on which they grow, membranaceous when dry, shrinking much, and generally closely adhering to paper. The *sporiferous nuclei* are sunk in the frond, but slightly prominent, like little pimples, to either surface, often of small size, and often aggregated in considerable numbers. They communicate with the surface by means of a canal which runs from the nucleus through the cortical layer of the frond, its mouth appearing as a superficial pore. The species are natives of the Tropical Ocean and of the warmer regions of the Temperate zone. One (*G. filicina*) is found as far north as the south of England.

1. Grateloupia *Gibbesii ;* frond (one to two feet long) flat, cuneate at the base, polymorphous ; lanceolate or wedge-shaped, simple, forked, or alternately multifid ; the laciniæ very long, lanceolate, acute ; margin entire or repand, or fringed with linear lobes which sometimes lengthen into pinnæ ; conceptacles immersed in the lamina, minute, scattered. (Tab. XXVI.)

Hab. On the breakwater at Sullivan's Island, Charleston, South Carolina, *Prof. Lewis R. Gibbes* and *W. H. H.*, January, 1850. (v. v.)

Fronds densely tufted, six, twelve, twenty inches in length, the laciniæ from half an inch to an inch and half wide at the widest part, tapering very much to the base and apex, flat, coriaceo-membranaceous, and rather thin, with the feel of fine kid leather. The ramification is so different in different specimens, that an adequate conception of the species can hardly be obtained without the comparison of many individuals. In some the frond is quite simple, lanceolate or cuneate, the margin flat, naked, or winged with lanceolate lobes on one or both sides. In others the frond divides at an inch or two above the base into ten or twelve laciniæ ; each several inches long, tapering greatly to both extremities, either perfectly flat and entire or with the margin undulate and repand, now and then furnished with a few secund pinnæ. Other specimens have the laciniæ forked or even palmate near the apex ; and in others a primary, linear lamina is pinnated throughout with linear-cuneate, simple or forked lobes. In fact, in the same tuft scarcely two specimens are similarly branched. *Colour*, when growing, a very dark, blackish purple ; changing more or less completely to a livid green in drying. *Conceptacles*, which

I have only as yet seen in an immature state, densely scattered through the lobes.

This is the largest and most *fucoid* plant in Charleston Harbour, and one of the noblest species of the genus. In the belief that it is distinct from the *G. Cutleriæ* of Valparaiso, its nearest relation, I give it the name of my friend Prof. Lewis R. Gibbes, as a memento of a delightful day spent in his company on the shores of Sullivan's Island.

Plate XXVI. *Fig.* 1. Grateloupia *Gibbesii;* the *natural* size. *Fig.* 2, a section of the frond, *magnified.*

2. Grateloupia *versicolor*, J. Ag. ; "frond (purple, changing to blackish green,) flat, thickish, pinnately decompound ; pinnæ linear, tapering at both ends, dentato-pectinate at the margin, the young teeth acuminate, at length growing out into horizontal, cuneato-linear pinnules." *J. Ag. Sp. Alg.* 2, *p.* 181.

Hab. At St. Augustin, Pacific coast of Mexico, *Liebman.*

3. Grateloupia *cuneifolia*, J. Ag.; "frond (blackish green when dry) flat, cuneate or linear, pinnate, here and there dilated and palmate, the margin and disc beset with lesser ciliary processes, segments linear, elongate, rather obtuse." *J. Ag. Sp. Alg.* 2, *p.* 181. *Kütz. Sp. Alg. p.* 732.

Hab. La Guayra, Gulf of Mexico, Herb. *Binder.*

4. Grateloupia *prolongata*, J. Ag. ; "frond (violaceous, turning greenish) compressed, nearly flat, undulated, interruptedly pinnate and proliferous from the disc, the apex lengthened out and naked ; pinnæ linear-subulate from a narrower base, long and short intermixed together." *J. Ag. Sp. Alg.* 2, *p.* 181. *Kütz. Sp. Alg. p.* 730.

Hab. Pochetti, Pacific coast of Mexican Republic, *Liebman*, (v. s. Herb. T. C. D.)

5. Grateloupia *filicina*, Ag. ; frond plano-compressed, pinnately decompound and proliferous from the disc, pinnæ narrowed at base, linear, acuminate, the lowest longest, and often pinnulate, the upper sub-simple ; nuclei numerous, immersed in the disc of the pinnæ. *J. Ag. Sp. Alg.* 2, *p.* 180. *Kütz. Sp. Alg. p.* 730. *Harv. Phyc. Brit. t.* 100. *Fucus filicinus, Turn. Hist. t.* 150.

Hab. Apalachichola, Florida, *Mr. Lounsbury.* (v. s. in Herb. T. C. D.)

I have seen but a single specimen, which appears identical with some of the Mediterranean forms of this variable plant.

XXIII. CATENELLA. *Grev.*

Frond sub-tubular, constricted at intervals as if jointed, dull purple, membranous; the axile portion composed of a lax net-work of anastomosing, longitudinal filaments, emitting to the periphery dichotomous, moniliform, horizontal branches, whose apices, strongly cohering together, form the membranous wall of the frond. *Nuclei* contained in the axile net-work of minute, ovate or roundish ramuli. *Tetraspores* also in small ramuli, lying among the dichotomous peripheric filaments, zonate.

Small, densely tufted, littoral Algæ of a dark purple colour. *Fronds* rising from matted creeping filaments, half an inch to an inch or two in height, vaguely branched, constricted into spurious joints, the branches resembling those of an *Opuntia* in miniature. The internodes are somewhat tubular, laterally compressed, hollow, except that a very lax net-work of anastomosing longitudinal filaments runs through them. From the exterior meshes of this net issue to all sides horizontal, dichotomous, moniliform filaments, whose apices, strongly glued together by firm gelatine, form the membranous wall of the frond. *Conceptacles* are very rare. *Tetraspores* are more frequently found.

The genus at present consists of two, or perhaps three species, if the form now to be described be entitled to specific distinction.

1. Catenella *pinnata ;* densely tufted, rising from creeping filaments ; stems erect, once or twice pinnate ; branches horizontally patent ; internodes oblong, the terminal ones acute, all the ramuli divaricate. (Tab. XXIX. B.)

Hab. On the stems of the mangroves, at high-water mark. Key West, *W. H. H.* (v. v.)

Fronds densely tufted, forming wide patches, rising from prostrate surculi, which are attached to the mangrove trunks by lateral discs. These prostrate surculi throw up numerous erect stems, half an inch to an inch high, divaricately pinnate or bipinnate; the branches horizontally patent, opposite or alternate, either naked or having a few secondary branches which are equally patent, the longer ones bearing a few ramuli. Branches moniliform ; the lower internodes sub-cylindrical, the upper compressed, oblong or sub-lanceolate, the ramuli spindle-shaped, acute or subacuminate. *Colour* a dark purple. *Substance* membranaceous, rigid. It does not adhere to paper.

Perhaps this is only a variety of *C. Opuntia ;* but it is much more regularly pinnated than any form of that species known to me, and the internodes are less frequently obovate.

Plate XXIX. B. *Fig.* 1, Catenella *pinnata;* the *natural* size. *Fig.* 2, part of a frond, *magnified.* *Fig.* 3, transverse section, and *fig.* 4, longitudinal semi-section of an internode; highly *magnified.*

XXIV. GLOIOSIPHONIA. *Carm.*

Frond terete, gelatinous, decompoundly much branched; *axis* composed of a column of densely interwoven, longitudinal, articulated filaments, at length hollow and tubular; *periphery* of verticillate, moniliform, dichotomous, fastigiate, densely packed filaments, set in gelatine. *Nuclei* (*favellæ*) immersed beneath the peripheric filaments, simple, containing, within a gelatinous envelope, numerous roundish spores. *Tetraspores* unknown.

This genus at present contains but a single species, a native also of the Atlantic Coasts of Europe. It is a brilliant carmine, very much branched, filiform plant, of a very tender gelatinous substance, and wholly composed of articulated, confervoid filaments, invested with transparent gelatine. A cross section of one of the youngest ramuli shows a solitary axial longitudinal filament, from which four verticillate, horizontal, dichotomous, fastigiate, moniliform branches issue, whose apices, closely pressed together and united by gelatine, constitute the periphery of the branchlet. An older branchlet, similarly treated, shows a solid columnar axis formed of the union of several filaments, from which spring a proportionably larger number of verticillate peripheric strings of cells. As older branches are successively subjected to the lens, the axis is seen to be more developed, until it results in a vast number of interlaced, anastomosing and branching longitudinal filaments densely packed together. Finally, either from distension, or the perishing of the central cells, the axis becomes hollow in the centre. *Favellæ* are generally very abundantly scattered through the branches. They are wholly immersed, and appear to be attached to the lower branches of the peripheric filaments. *Tetraspores* are unknown.

1. Gloiosiphonia *capillaris*, Carm.—*J. Ag. Sp. Alg.* 2, *p.* 161. *Kütz. Sp. Alg. p.* 714. *Harv. Phyc. Brit. t.* 57. *Fucus capillaris, Turn. Hist.* 31. *E. Bot. t.* 2191.

Hab. Nahant, *Mrs. Mudge.* Hampton Beach, *Dr. Durkee.* Chelsea, *Miss E. H. Brewer.* New London, *Miss French.* (v. s. in Herb. T. C. D.)

Frond 4—6 inches long, 1—2 lines in diameter, the older parts hollow and tubular, the younger filled with longitudinal threads, excessively and irregularly branched; the branches spreading towards all sides. Main stem sub-simple, terete,

tapering to the base and apex, naked for an inch or two above the base, afterwards very densely set with lateral branches, which are many times decompound, with several series of lesser branches and ramuli. *Ramuli* tapering remarkably to the base and apex; the alternate ones very slender, setaceous, attenuated. *Colour* a brilliant carmine. *Substance* elastic, shrinking in drying. It closely adheres to paper.

The American specimens, here described, closely resemble those from Europe.

Order XII. SPYRIDIACEÆ.

Spyridieæ, J. Ag. Sp. Gen. and Ord. Algarum, vol. 2, *p.* 337. *Part of Ceramiaceæ, J. Ag. and Auct. Harv. Man. Ed.* 2, *p.* 156.

Diagnosis. Rosy or brown-red sea-weeds, with a filiform, articulate, monosiphonous frond, partially or entirely coated with small cellules. *Conceptacles* external, furnished with a closed, cellular pericarp, containing numerous *nucleoli*, formed by the transformation of spore-threads radiating from a placenta: these spore-threads are much branched, articulated, and produce in their upper cells, by repeated divisions of the endochrome, numerous oblong spores, which are at length massed together without order. *Tetraspores* external, on the ramelli.

Natural Character. *Root* an expanded disc. *Fronds* filiform, articulated, the tube coated externally by a stratum of small, polygonal coloured cellules, which at length conceal the articulations, except in the young branches. *Stem* much branched, alternately or pinnately compounded, all the lesser divisions clothed with minute, setaceous ramelli. *Ramelli* simple, pellucidly articulate, or coated at the nodes with small cellules.

Conceptacles external, pedicellate, roundish or lobed, formed by the metamorphosis of one of the smaller branches. *Pericarp* closed, formed of a stratum of polygonal cells. Its contents are thus described by Prof. J. Agardh: "*Placenta* central, continuous from the peduncle, and prolonged to the apex of the cavity, formed of dense, dichotomo-fastigiate and anastomosing filaments woven together. From this central column of the conceptacle issue filaments (as it were branches) radiating in all directions, many of them elongated and sterile, some shorter and fertile. The sterile filaments are nearly regularly dichotomous, articulated, passing off at the apices into the pericarpal cells; the fertile form many fascicles, directed to the

different lobes; the younger filaments paniculately branched, with short oblong articulations, the mature ones constituting an obconic cluster of spores. These spores, which originate in a cell-division of the articulations, are oblong; at length, by mutual pressure, angular, separated from one another and held together by a firm gelatine." *J. Ag. Sp. Alg.* 2, *p.* 337.

The *tetraspores* are formed along the sides of the ramelli; either from the evolution of new cells or of those of the cortical layer. They are triangularly parted, and sessile.

At present this Order consists of a single genus, separated by Prof. Agardh from the *Ceramiaceæ*, on account of the very different structure of its conceptacular nucleus, a character by which it is more nearly related to the *Rhodymeniaceæ* than to any other family. The structure of the frond, on the contrary, is identical with that of the former family, so much so, that the species of *Spyridia* were formerly referred to *Ceramium* itself.

Possibly when the conceptacles of *Ballia* are better known, that genus will form a second in this very distinctly characterised though at present fragmentary Order.

I. SPYRIDIA. *Harv.*

Frond filiform, terete or compressed, decompoundly much branched, composed of a single, articulated, thick-walled filament, coated externally with a thin layer of small coloured cellules; and more or less beset with slender, deciduous, articulated *ramelli*. *Conceptacles* at the ends of short branches or peduncles, involucrated with a few ramelli, containing within a closed, membranous pericarp, numerous *nucleoli* of oblong spores. *Tetraspores* formed along the ramelli, external, sessile, triangularly parted.

The few species of this genus yet known to botanists are all natives of the warmer parts of the ocean. *S. filamentosa* is the most widely dispersed of any, being found throughout the tropics of the Eastern and Western Hemisphere; in the Mediterranean Sea, and along the Atlantic shores of Europe as far as the South of England; and on the East coast of North America, from Florida as far North as Massachusetts Bay. As might be expected in a plant of such indifference to climate, it varies much both in the luxuriance of its filaments and the amount of their ramelli; also, though in a less degree, in the primary ramification. Our var. *refracta* almost looks like a species.

1. Spyridia *filamentosa*, Harv.; frond filiform, decompoundly branched; branches alternate, repeatedly divided, ramellose; ramelli scattered, hair-like, articulate, end-

ing in a simple, acute point. *J. Ag. Sp. Alg.* 2, *p.* 340. *Harv. Phyc. Brit. t.* 46. *Conferva Griffithsiana*, *E. Bot. t.* 2312. *β refracta ;* frond robust, sub-dichotomous, the branches divaricating, with very wide axils, arched ; the terminal ones frequently revolute, all but the youngest branches bare of ramelli ; ramelli as in the ordinary varieties. (Tab. XXXIV. A.)

Hab. Massachusetts Bay, *Capt. Pike.* Newhaven, *Mr. Hooper.* Stonington and Newport, *Prof. J. W. Bailey.* Red Hook, New York, *Mr. Walters, &c.* Greenport, Long Island, *W. H. H.* Key West, *Dr. Wurdeman ; W. H. H. β* at Key West, *W. H. H.* (v. v.)

Very variable in size and ramification. *Frond* three to eight or ten inches long, sometimes only as thick as hog's bristle, sometimes twice or thrice as thick ; generally much branched, but very irregular in the order of branching. *Branches* spreading, many times compounded, the younger ones especially beset with hair-like ramelli a line or two in length. These ramelli are articulated, each internode formed of a single cell which varies in proportionate length and breadth in different specimens ; the nodes are coated with a ring of small cellules, from some of which the tetraspores are evolved in fertile specimens. *Conceptacles* pedicellate, terminating short branches, surrounded by a few involucral ramelli, bi-trilobed, each containing several distinct clusters of spores. *Tetraspores* oval, clustering round the nodes of the ramelli. *Colour* a purplish-red, changing through various shades of brown to dingy yellow-white. *Substance* soft, but not lubricous. It does not adhere strongly to paper in drying, and is without gloss.

β is a very remarkable variety. The frond is of much greater diameter than in the ordinary American forms, and has thinner walls. Our fig. 1 is strictly characteristic of the extreme form of this variety ; and I should have considered it specifically distinct, had not intermediate forms accompanied these strangely straggling ones, connecting them with the well-known European vars. *nudiuscula*, *repens*, &c. By Kützing, indeed, these and other varieties, in all some sixteen, are erected into species ; but I fear, were the characters given by this author to be regarded as specific, it would be easy to quadruple the number of *such* species, if a sufficiently extensive suite of specimens were closely examined.

Plate XXXIV. A. *Fig.* 1. Spyridia *filamentosa*, var. *refracta ;* the *natural* size. *Fig.* 2, branchlet and ramelli ; *fig.* 3, apex of a ramellus ; *fig.* 4, small portion of the stem ; *fig.* 5, the same cut open longitudinally ; *fig.* 6, a transverse section of the same ; more or less highly *magnified.*

2. Spyridia *aculeata*, Kütz. ; frond filiform, decompoundly much branched, branches excessively divided, ramellose ; ramelli densely set, hair-like, articulate, having three or more uncinate prickles at the extremity. *J. Ag. Sp. Alg.* 2, *p.* 342. *Kütz. Sp. Alg. p.* 668. (*Excl. Syn.*) *Spyridia Berkeleyana*, *Mont. Fl. Alg. p.* 141, *t.* 15, *f.* 6, *Kütz. l. c.*

Hab. At Sand Key, Florida, *W. H. H.* (74.) (v. v.)

Fronds densely tufted, four to five inches long, as thick as sparrow's quill below, gradually attenuated, setaceous above, branched on every side, bushy, excessively divided. *Branches* virgate, two or three inches long, with a lanceolate outline, closely set with lateral, simple or alternately compounded lesser branches. All the younger parts of the frond are beset with scattered ramelli half a line to a line in length, articulated, the nodes more or less coated with accessory cells and the apex armed with three (or rarely four) hooked prickles, of which one is terminal and the others lateral. *Colour* a fine purplish lake. *Substance* soft, soon decomposing in fresh water. In drying, it adheres to paper.

A much more densely branched and more feathery plant than any variety of *S. filamentosa* which I have seen, and readily distinguished by the hooked spines which terminate the ramelli. On many of my specimens some of the branches are incrassated below the apex; the incrassated portion bare of ramelli and strongly revolute, forming a short tendril. They were not found attached, however, by these hooks to any neighbouring Algæ.

Order XIII. CERAMIACEÆ.

Ceramieæ, J. Ag. Sp. Gen. and Ord. Algarum, vol. 2, *p.* 1. *Ceramieæ, J. Ag. Alg. Med. p.* 69. (*in part*). *Endl. Gen. Pl. Suppl.* 3, *p.* 34. *Harv. Man. Ed.* 2, *p.* 156, *&c.*

Diagnosis. Rosy or red brown sea-weeds, with a filiform, articulate, or partially or entirely corticated, monosiphonous frond; the outer coat (when present) formed of polygonal cells. *Conceptacles* naked or involucrated *favellæ;* that is, masses of roundish-angular congregated spores, enclosed in a hyaline gelatino-membranaceous saccate envelope. *Tetraspores* external or superficial, formed either from the ultimate ramuli of the simpler fronds, or the cortical cells of the coated ones.

Natural Character. *Fronds* generally growing in dense tufts, sometimes solitary, rising either from creeping fibres or more commonly from discoid roots. In the simpler species, the frond consists of an articulated filament, formed of a number of cylindrical *cells* or *articulations*, placed end to end. This filament is

either dichotomously, or pinnately branched, the branches being similar to the main stem, and always springing from the upper part of each internode (or articulation) either from its shoulder, or from a short distance below that point. In some genera a number of such filaments anastomose together so as to form a net-work or sponge-like frond, each mesh of the net being usually formed by as many cells or articulations as it has sides; none with this habit, however, are yet known as North American. In the filiform species the primary, articulated, filamentous frond has either the simple structure described above, or it is more or less completely covered over and rendered opaque by cortical cellules, which are sometimes developed on the outer surface of the primary cell, but often formed within the thickened cell-walls. The formation of such cortical cells commences at the nodes and proceeds downwards, the lower part of the articulation being the last coated. These cells are frequently deposited in linear series, but sometimes form a honeycombed surface. In several *Callithamnia* the stem, which in the young frond is pellucidly articulate, becomes as the plant advances in age gradually opaque, by the development of numerous longitudinal articulated filaments within the transparent gelatino-cartilaginous cell walls. These filaments originate at the points from which the branches and ramuli spring, and grow downwards toward the base of the stem. They are indeed like *roots* to the branches; as if each branch sent forth many fibrous roots through the substance of the stem; and in their growth they illustrate, analogically, the similar development of wood tissue from the bases of leaves. In young specimens of *Cal. Baileyi*, the gradual progress of formation of these filaments may be readily seen.

In the more compound fronds, such as occur in the genera *Ptilota* and *Microcladia*, no articulation is visible in the stem, because the primary articulated filament is enclosed in a cellular coat, composed sometimes of many rows of small polygonal coloured cellules. It is only in the very youngest parts of these plants that articulations are partially visible; but, on dissection, the monosiphonous filament which characterises all the plants of this Order is found running, as an axis, through every part of the frond. These opaque species therefore only differ from the pellucidly articulated ones, by the greater development of the cortical cellules.

The *conceptacular* fruit is of the kind called by Agardh a *favella*. It is formed by the metamorphosis of one of the articulations or primary cells of a branch; either of the terminal cell of a shortened branch, or of one of the upper cells. The cell wall dilates, and becomes the transparent envelope or periderm to the *spores*, which are formed by the repeated sub-division of the endochrome of the cell. These *favellæ* are frequently in pairs or clusters, and are either naked or surrounded by short involucral ramuli.

The *tetraspores* are usually tripartite, rarely cruciate, and still more rarely zonate. They are very frequently external, either sessile on the sides of the ramuli, or on little pedicels, in these cases originating in a transformation of the ultimate divisions of the frond. Sometimes they are half immersed, and rarely wholly sunk among the surface cellules of the compound fronds; in these cases being formed from some of the cortical cellules.

Antheridia have been found in several. They generally occupy the same position on the frond as the tetraspores, and consist of innumerable minute, hyaline cellules strung in moniliform filaments, radiating from a central point; each of these tufts of filaments being about the size of a tetraspore.

Seventeen or eighteen genera of this Order are known. Of these the following are represented on the North American Coasts.

SYNOPSIS OF THE NORTH AMERICAN GENERA.

TRIBE 1. CERAMIEÆ. *Tetraspores* (formed by a metamorphosis of some of the cortical cellules) more or less sunk in the frond.

I. MICROCLADIA. *Frond* not obviously articulate.

II. CENTROCERAS. *Frond* articulated, corticated; the cortical cells rectangular, longitudinally seriated.

III. CERAMIUM. *Frond* articulated, more or less corticated; the cortical cells roundish, irregularly distributed.

TRIBE 2. CALLITHAMNIEÆ. *Tetraspores* (formed by a metamorphosis of a whole ramulus or of an articulation) external, sessile or pedicellate.

IV. PTILOTA. *Frond* corticated, decompound-pinnate. *Favellæ* involucrate.

V. CROUANIA. *Frond* gelatinous, articulated; the stem and branches moniliform, whorled with minute, densely set ramelli, among which the *favellæ* are sunk.

VI. HALURUS. *Frond* cartilaginous, articulated; branches whorled with forked ramelli. *Favellæ* involucrate.

VII. GRIFFITHSIA. *Frond* gelatino-membranaceous, articulate, dichotomous. *Favellæ* involucrate.

VIII. CALLITHAMNION. *Frond* articulate, (the stem and branches occasionally subopaque). *Favellæ* naked.

I. MICROCLADIA. *Grev.*

Frond compressed, decompound-dichotomous, or sub-pinnate, distichous, with an articulated axial filament, corticated, opaque; the cortical stratum formed internally of large angular cells, externally of minute ones. *Favellæ* sessile on the branches, subtended by a few involucral ramuli, and containing, in a hyaline periderm, numerous angular spores. *Tetraspores* immersed in the ultimate segments, formed out of some of the superficial cells, triangularly divided.

This genus was founded by Dr. Greville on the *Fucus glandulosus* of the Banksian Herbarium, a little plant found along the European shores from the Coast of Ireland to the South of Spain, as well as in the Mediterranean Sea; and which possibly awaits discovery on the Atlantic shores of America. It closely resembles *Ceramium rubrum* in habit, but is evidently compressed, and much more opaque, the cortical layer being formed of several rows of coloured cells. To this original species I venture to add the two following from the Pacific Coast.

1. Microcladia *Coulteri;* frond inarticulate, compressed, distichous, decompound-pinnate; branches alternate, elongate, simple, bi-tri-pinnate; pinnæ and pinnulæ plano-compressed, without evident articulation, the ultimate ramuli broadly subulate, acute; favellæ sub-globose or bilobed, sub-tended by two or three short ramuli. (Tab. XXXIII. A.)

Hab. California, *Dr. Coulter.* (v. s. in Herb. T. C. D.)

Frond six or eight inches long, half a line in diameter, compressed, becoming more so upwards, slightly flexuous, undivided or slightly divided, set throughout, at distances of half an inch, with lateral, undivided, virgate branches. These branches are erecto-patent, pinnated with shorter branches or pinnæ, half an inch to an inch or more in length; the lowest shortest, the rest successively longer to the middle of the branch, and thence again shorter to the apex. The *pinnæ* are plano-compressed, about bi-pinnate, all the divisions alternate and erecto-patent, the ultimate ramuli subulate and acute; the apical laciniæ hooked inwards. No articulation is externally visible in any part of the stem or ramuli when examined with a microscope, but the internal articulated axial filament may be seen in some places with a pocket lens. A section of one of the upper branches shows a large central tube, surrounded by several series of polygonal cells; the inner large, the rest successively smaller to the circumference, which is formed of minute cells. A cross section of the base of the stem has a very different aspect: it exhibits a large central tube, though considerably shrunk from that of the branches, surrounded by one or more circles of large cells, separated from the central tube and from each other by

wide interstices filled with minute, filiform cellules. The stem does not readily recover its form when moistened after having been dried, and this structure, attempted to be shown is *fig.* 5, is not correctly given ; the specimen from which it was drawn not having opened sufficiently. This difference in structure between the branches and stem originates in causes exactly similar to those that operate in some *Callithamnia*, in which the branches at first consist of a string of transparent-walled cells, but afterwards have their walls filled from above with filaments, issuing from the butts of the branches and gradually accumulating toward the base of the frond. The *favellæ* are formed on slightly shortened pinnules, and are roundish, subtended by two or four subulate ramuli. *Colour* a purplish red.

This is so similar to some varieties of *Ceramium cancellatum* that I had at first referred it to that species ; but it is much more robust, more opaque, of a different internal structure, and moreover the pinnæ and pinnulæ, which are lanceolate in circumscription, are alternately rather than dichotomously compounded.

Plate XXXIII. A. *Fig.* 1. Microcladia *Coulteri*, the *natural* size. *Fig.* 2, a pinna; *fig.* 3, a pinnule with *favella* ; *fig.* 4, a longitudinal, and *fig.* 5, a transverse section of the base of the stem (not quite correct); the latter figures more or less highly *magnified.*

2. Microcladia *borealis*, Rupr.; frond inarticulate, distichous, dichotomo-secund, many times compounded ; branches arched, virgate, set along their upper sides with numerous, secund pectinato-dichotomous, twice or thrice secundly compounded branchlets ; ultimate ramuli incurved, acute ; tetraspores in the ultimate ramuli, irregularly scattered. *Rupr. Alg. Ochotsk. p.* 259. *Microcladia scorpioides*, *Harv. MS. in Herb.*

Hab. Una Nootka, *Dr. Scouler !* Fort Vancouver, 1826, *Garry !* Unalaschka, *Wosnessenski !* Golden Gate, California, *Capt. Pike !* (v. s. in Herb. T. C. D.)

Densely tufted. *Fronds* three to four inches long, as thick as hog's bristle, so closely coated with peripheric cells that no articulation is visible in any part of the frond without dissection. Internal structure as in the genus. The branches and all their subsequent divisions, though formed on a dichotomous type, appear from the nearly constant regular suppression of one of the arms of the bifurcation to be secund. The main branches are arched backwards, long and virgate, and closely set with falcato-secund, distichous secondary branches, from half an inch to an inch in length, and about a quarter inch apart. Each of these carries on its upper side five or six secund ramuli, which are again once or twice compounded in a similar manner. This order of ramification seems perfectly regular, without a trace of proliferous growth. *Tetraspores* are abundantly scattered through the surface cells of the ultimate ramuli in Capt. Pike's specimen.

This appears to be a very distinctly characterised species and to belong to the present genus, although it bears some external resemblance to *Ceramium obsoletum*,

Ag. It is much more opaque than that species, with a smaller axial tube and shorter articulations, and the ramification is as orderly as in *Plocamium coccineum*.

CENTROCERAS. *Kütz.*

Frond filiform, dichotomous, articulated, corticated with oblong cells, arranged round the internode in longitudinal lines. *Favellæ* sessile on the branches, subtended by a few involucral ramuli, and containing, within a hyaline periderm, many angular spores. *Tetraspores* formed by a transformation of some of the cortical cells, projecting from the surface, roundish, triangularly divided.

Plants with the external habit of *Ceramium*, from which genus this chiefly differs in having the cells of the cortical layer arranged in longitudinal, striæform rows, instead of being irregularly placed. Of the following species, which has many varieties, and is dispersed very widely through the Atlantic and Pacific Oceans, Prof. Kützing has made no less than eight species.

1. Centroceras *clavulatum*, Ag. ; frond capillary, rigid, dichotomous, fastigiate, at length proliferous from the axils ; apices hooked inwards, lower internodes four to six times as long as broad, upper successively shorter ; nodes armed with a whorl of minute spines ; tetraspores whorled round the nodes of the lesser branches and ramuli ; favellæ geminate, involucrate. *J. Ag. Sp. Alg.* 2, *p.* 149. *Centroceras sp. omnes, Kütz. Sp. Alg.* 688. (Tab. XXXIII. C.) *β crispulum*, Mont. ; filaments variously curved and twisted, and beset with lateral, squarrose ramuli, *Mont. Cuba. t.* 2, *f.* 1.

Hab. Abundant at Key West, on rocks, on the foundations of the Fort and elsewhere near low water mark, *W. H. H.* (both varieties), *Prof. Tuomey*, &c. (v. v.)

Fronds densely tufted, two to four inches long, as thick as human hair, nearly of the same diameter throughout, repeatedly and regularly dichotomous, the apices fastigiate ; branches straight and erect in var. *α*, variously twisted and spreading in *β*, naked, or furnished with lateral, proliferous, forked branchlets, which spring either from any node along the stem or often from the axils, especially the upper ones. *Frond* articulated to the base ; the internodes in the lower part several times longer than broad, shorter above and very short towards the ends of the ramuli. coated with cells arranged in longitudinal striæform lines ; the cellules toward the apex of each internode short, quadrate, gradually longer toward the base, and

always longest in the older parts of the frond. The *nodes* are universally swollen, thicker than the internode above and below, each internode sitting in the one below it as in a little cup. In the young state each node is crowned with a whorl of minute spine-like processes, which are gradually obliterated in age, and are only to be found, in old plants, on the youngest branches. Young plants are also covered with copious, very slender hairs, afterwards deciduous. *Favellæ* subtended by three or four small branchlets. *Tetraspores* rather prominent, whorled round the nodes of the lateral ramuli. *Colour* a dark purple, passing into brick-dust-red in fresh water. *Substance* rigid and harsh. It does not adhere to paper in drying.

Plate XXXIII. C. *Fig.* 1. A tuft of CENTROCERAS *clavulatum*, the *natural* size. *Figs.* 2 and 3, portions of filaments of different ages ; *fig.* 4, apex of a branch ; *fig.* 5, internodes of the stem ; all more or less *magnified*.

III. CERAMIUM. *Lyngb.*

Frond filiform, dichotomous or somewhat pinnate, articulate ; the articulations either partially or wholly coated by small cells not arranged in lineal series. *Favellæ* sessile on the branches, subtended by a few involucral ramuli, and containing, within a hyaline periderm, many angular spores. *Tetraspores* formed by a transformation of some of the cortical cells, more or less projecting from the surface, roundish, triangularly divided.

The fronds generally grow in dense tufts, seldom exceeding six inches in height, and often not half that measurement. The stems vary in diameter from the thickness of a hog's bristle, or rather more, to the fineness of a cobweb. Some species are so completely corticated with minute coloured cellules as to be nearly opaque ; others are beautifully variegated with hyaline and coloured bands alternately placed ; the coloured or corticated portion of each cell being that nearest to the node, the hyaline band occupying the central region of the internode. Many of the species, perhaps all, are, when young, clothed at the nodes with very fine, soft, hyaline hairs, which, as the frond advances in age, fall away, leaving the articulation quite smooth. Other species are armed at the nodes with thorn-like processes or prickles, but none of this section have yet been found in North America.

The number of *book*-species has been largely increased of late years, partly by the discovery of new forms, and partly by splitting into several the *specific ideas* (so to say) of the older botanists. Some of these newly proposed species are no doubt proper to be retained, but I fear the splitting process has been carried far beyond its legitimate limits. The North American species naturally divide into two sections, in the first of which the cortical cells cover over either the whole of the

articulation or the greater portion of it; in the second, they are confined to a definite band surrounding the nodes.

Sect. 1. Rubra; *Frond unarmed (not spinuliferous); the stratum of cortical cells decurrent from the nodes, and more or less completely clothing the surface of the internode.*

1. Ceramium *nitens*, J. Ag.; frond subsetaceous, slightly attenuated upwards, irregularly dichotomous, diffuse, the branches widely spreading and divaricating; upper branches zig-zag, with lateral, distant, frequently secund branches and ramuli; ultimate ramuli scattered, subulate, straight at the point; internodes clothed with cells on all parts of the frond, the lower ones twice as long as broad, the upper very short. *J. Ag. Sp. Alg.* 2, *p.* 130.

Hab. At Key West, Florida, *W. H. H., Prof. Tuomey*, No. 18, (v. v.)

Frond four to eight inches long, not so thick as hog's bristle, dichotomously branched from the base, all the divisions very patent, often spreading at right angles, and sometimes with still greater divergence. The upper forks are equally wide with the lower, but are less regular; one arm of the dichotomy being frequently shortened to a branchlet. Thus the ramification becomes as it were alternately zig-zag or secund. Ramuli few or many, filiform, simple, acute, not forcipate at the extremity, distant and very patent. *Substance* rather firm. *Colour* a full red or brownish. *Fruit* unknown. *Internodes* uniformly coated with small cells, not much or at all contracted at the nodes.

I have not seen specimens of Agardh's plant, and may be wrong in the above reference. But be this as it may, I have no hesitation in regarding the plant here described as a distinctly marked species, differing from *C. rubrum* not merely in ramification, but essentially in structure. If cross sections of both plants be compared together under the microscope, the differences may be readily seen. In our *C. nitens* the walls of the monosiphonous frond are very thick, and the peripheric cells are set within the pellucid substance of the wall in dichotomous, radiating, horizontal series, whose apices constitute the superficial coating. In *C. rubrum* the surface cellules are of large size, not disposed in radiating lines, and a circle of empty, polygonal cells surrounds the central tube, as in *Microcladia*.

2. Ceramium *rubrum*, Ag.; frond robust, setaceous, gradually attenuated, dichotomous, sub-fastigiate, with or without lateral simple or forked ramuli; segments erecto-patent, the apices either slightly incurved or hooked; lower internodes twice or thrice as long as broad, contracted at the nodes, more or less densely covered with surface cellules; favellæ lateral, subtended by three or four short ramuli; tetraspores distributed round the nodes. *J. Ag. Sp. Alg.* 2, *p.* 127. *Kütz. Sp. Alg.*

p. 685. *Harv. Phyc. Brit*, *t.* 181. *Conferva rubra*, *E. Bot. t.* 1166. *Dillw. Conf. t.* 34.

β decurrens ; the younger internodes naked in the middle, the older gradually covered over with cellules ; frond either regularly dichotomous or furnished with lateral, forked ramuli. *Ceramium decurrens*, *Kütz. Sp. p.* 675. *Harv. Phyc. Brit. t.* 276.

γ proliferum ; internodes densely covered with cells ; frond dichotomous, beset on all sides with numerous, lateral, simple or forked branchlets. *Ceramium botryocarpum*, *Griff.—Harv. Phyc. Brit. t.* 215.

δ secundatum ; similar to var. *γ*, except that the ramuli are very generally secund. *Cer. secundatum*, *Lyngb. Hyd. Dan. t.* 37, *A*.

ε squarrosum ; frond of small size, regularly dichotomous, fastigiate, with very few and short lateral ramuli ; lower forks distant, with patent axils ; upper very close together, very patent, the segments divaricating and apices sometimes revolute.

Hab. Pacific Coast. Atlantic Coast from the Arctic Sea to Charleston, South Carolina. *β*, Prince Edward's Island, *Dr. Jeans*. Halifax, *W. H. H.* New Bedford, *Dr. Roche*. *γ*, Newport, *Prof. Bailey*. *δ*, Newfoundland. *ε*, growing on Zostera, Boston Harbour, *Mr. G. B. Emerson*. Lynn, *Mrs. Mudge*. (v. v.)

Frond two to ten inches long, thicker than hog's bristle below, attenuated upwards and capillary in the ultimate ramuli, pretty regularly dichotomous ; the lower forks distant, the upper approximated, with rounded axils and erecto-patent slightly converging segments. Young specimens are generally simply dichotomous ; older ones have often numerous lateral ramuli, half an inch in length, simple or forked. Sometimes these are very numerous, as in vars. *γ* and *δ*. In var. *β*, the stem and branches are beautifully variegated with alternate pale and coloured bands. In the other varieties the internodes are uniformly coloured. Our var. *ε* is a very remarkable form, two to three inches high, fastigiate, with very patent squarrose ramification. It almost looks like a distinct species, but seems traceable through varying specimens into the common form. *Colour*, varying through nearly every shade of red to orange, yellow, dirty white or greenish.

Many more varieties than those above enumerated occur on our coasts. The above are, however, the most distinctly marked.

Sect. 2. Diaphana ; *Frond unarmed* (*not spinuliferous*) ; *the stratum of cortical cells confined to a definitely limited band round the nodes ; the internodes diaphanous.*

3. Ceramium *Hooperi ;* fronds rising from creeping surculi, densely matted below, erect, capillary, irregularly dichotomous ; ramuli scattered, erect, subulate, straight, or slightly curved, (the ends of the branches frequently bearded at one side with a series of thick, root-like fibres, one rising from every node) ; articulations in all parts of the frond of equal length and breadth, the internode formed of

a single, naked, coloured cell; the node coated with a definite band of large cellules.

Hab. On perpendicular rocks, densely covered with Fuci, near low-water mark. Camden, Penobscot Bay, *Mr. J. Hooper*. Newburyport, *Capt. N. Pike*. (v. s. in Herb. T. C. D.)

This spreads over the surface of the rock in dense, root-like patches. The filaments are an inch or two in height, possibly more in full-grown specimens, irregularly dichotomous, and furnished with scattered, lateral ramuli, which are either straight, or slightly curved at the point. The stems spring from a mat of confervoid fibres; near the base the cortical layer of the nodes is very narrow, the internode being formed of a single, thick-walled cell, containing a dark purple endochrome. The nodes in the upper part of the filament have a wider, but always a strictly defined band of cortical cells, and the internodes throughout the filament consist of a single large cell filled with endochrome. Most of the branches in Mr. Hooper's specimens throw out from several of the nodes, below the tips, a number of secund, hyaline, root-like filaments, one-fourth of the diameter of the part from which they spring, one rising from the marginal cell of each node. *Fruit* at present unknown.

I have the more pleasure in naming this curious plant after its discoverer, Mr. J. Hooper of Brooklyn, because I believe it to be distinctly marked by the structure of its articulations, as well as by its creeping habit. The bearded extremities of the branches afford a very unusual character, but I fear to ground a diagnosis on them, as they do not occur in a specimen from Capt. Pike, which differs in no other respect from those collected by Mr. Hooper.

4. Ceramium *diaphanum*, Roth; filaments setaceous, attenuated upwards, rather flaccid, irregularly dichotomous; the branches set with short, lateral, dichotomous ramuli; internodes colourless, those of the main stems three or four times as long as broad, of the ramuli short; nodes swollen, coated with a definite band of purple cellules; favellæ near the ends of the branches or of small ramuli; tetraspores numerous in each node. *J. Ag. Sp. Alg.* 2, *p.* 125. *Harv. Phyc. Brit. t.* 193. *Hormoceras diaphanum*, *Kütz. Sp. Alg. p.* 675. *Conferva diaphana*, *E. Bot. t.* 1742. *Dillw. Conf. t.* 38.

Hab. Boston Bay, *Dr. Durkee*. Nahant, *Mrs. Mudge*. New Bedford, *Dr. Roche*. Providence, *Mr. Olney* and *Prof. Bailey*. New York Bay, *Messrs. Hooper*, *Walters*, *Pike*, *Calverley*, &c. Key West, *Mr. Binney*, *Dr. Blodgett*, *W. H. H.* (v. v.)

Frond two to four inches high, variable in diameter, as thick as hog's bristle or as horse hair below, gradually attenuated upwards and nearly capillary above, irregularly dichotomous, with many lateral, dichotomous branchlets of various lengths; apices rarely fastigiate, but more so in some varieties than in others.

Ultimate ramuli forcipate at the apex. Sometimes the lateral branches are few, simply forked, and distantly scattered along the branches, either alternate, or secund ; sometimes they are very numerous, springing from nearly every node. *Internodes* hyaline, destitute of cortical cells, those of the lower branches three or four times as long as broad, the upper ones successively shorter. *Favellæ* involucrate, mostly sessile near the ends of the lateral ramuli. *Tetraspores* either in the ramuli or the main branches, densely whorled round the node, prominent. *Colour* of the tuft a dark purple. *Substance* soft, adhering to paper in drying.

5. Ceramium *subtile*, J. Ag. ; "frond capillary, dichotomous, sub-alternately branched above, branches elongate, set with patent, forcipate ramuli ; lower internodes twice or thrice as long as broad, upper successively shorter ; nodes scarcely swollen ; tetraspores secund on the outer edge of the segments, rather prominent." *J. Ag. Sp. Alg.* 2, *p.* 120.

Hab. Vera Cruz, Gulf of Mexico, *Liebman.*

Said to be allied to *C. gracillimum ;* but is of greater diameter, with more patent, by no means fastigiate ramuli, shorter lower articulations, less swollen nodes, and differently disposed tetraspores. I have not seen any specimens.

6. Ceramium *tenuissimum*, Lyngb.; frond capillary, of equal diameter throughout, rigid, dichotomous, excessively divided, fastigiate; the axils very patent ; internodes colourless, those of the middle of the stem from four to six times as long as broad, the upper successively shorter ; nodes swollen ; tetraspores very prominent, secund on the outer edge of short lateral ramuli, one or more at each node ; favellæ involucrate, near the tips of short ramuli. *J. Ag. Sp. Alg.* 2, *p.* 120. *Ceramium nodosum*, *Harv. Phyc. Brit. t.* 90. *Gongroceras nodiferum*, *Kütz. Sp. Alg. p.* 678, *also G. tenuissimum*, *Kütz. l. c. p.* 680.

Hab. Key West, Florida, *W. H. H.*, *Prof. Tuomey*, *Mrs. Adams.* Key Biscayne, *Prof. Tuomey.* (v. v.)

Tufts two to three inches long, globose, fastigiate. *Filaments* much finer than human hair, many times dichotomous with very patent angles and spreading branches and ramuli. *Apices* diverging, forcipate. The lower forks are distant, the upper gradually nearer. The lateral ramuli are either simple or forked, hooked in or forcipate at the ends. They bear the fructification of both kinds. *Colour*, a pale or dark purplish red, changing to ferruginous-red in fresh water. *Internodes* of the ramuli very short, of the lower branches successively longer, and 5—6 times as long as broad in the lower part of the plant. Nodes generally swollen.

The American specimens here described are destitute of fruit, and are so far, therefore, uncertain ; but in other respects are very similar to European specimens.

7. Ceramium *fastigiatum*, Harv.; frond capillary, of equal diameter throughout, flaccid, dichotomous, level-topped; the axils acute; internodes pellucid, the lower ones nearly colourless, from four to six times as long as broad, the upper successively shorter, and filled with pale rose-coloured endochrome; nodes banded; favellæ sub-terminal, involucrated; tetraspores prominent, secund on the outer edge of the branches. *J. Ag. Sp. Alg.* 2, *p.* 119. *Harv. Phyc. Brit. t.* 255. *Gongroceras fastigiatum*, *Kütz. Sp. Alg. p.* 678.

Hab. Massachusetts Bay, *Dr. Durkee*, *Captain Pike.* Greenport, *W. H. H.* Newport, *Prof. Bailey*, *Mr. Olney*, *&c.* Longbranch, New Jersey, *Miss Morris.* (v. v.)

Tufts very dense, fastigiate, soft. *Filaments* finer than human hair, many times regularly dichotomous, the lower axils sub-distant, the upper gradually nearer, not widely spreading. Apices of all the branches generally on a level, the ultimate divisions forcipate. Occasionally there are a few lateral ramuli. Internodes pellucid, but suffused with a pale blush, the uppermost ones filled with rosy endochrome. *Nodes* coated with a definite band of small cells. General colour of the tuft a bright lake-red, becoming in fresh water first scarlet and then orange.

The American specimens are very similar to those from the South of England and Ireland.

8. Ceramium *arachnoideum* (?) Ag.; tufts fastigiate, dense; filaments capillary, attenuated upwards, many times regularly dichotomous; axils more or less patent, the lower distant, the upper close; apices forcipate, not strongly inflexed; internodes pellucid, the lower ones thrice or four times as long as broad (sometimes veiny), upper very short; favellæ lateral, subtended by elongating ramuli (at length axillary); tetraspores bursting from the outer edge of the nodes, especially of the upper branches, solitary or aggregated, very prominent. *J. Ag. Sp. Alg.* 2, *p.* 117. *β patentissimum;* of small size, the lower furcations distant and very patent; the branches ending in dichotomo-multifid, divaricating, corymboso-fastigiate ramuli; internodes of the ramuli extremely short. (Tab. XXXIII. B.)

Hab. Boston Bay, *Dr. Durkee*, *Capt. N. Pike.* Newhaven, *Mr. J. Hooper.* Bayside, New York Bay, *Mr. J. Hooper.* Hellgate, *Mr. Walters.* Var. *β*, Boston Bay, *Dr. Durkee and Capt. N. Pike.* New York Harbour, *Mr. Walters and Mr. Hooper.* (v. s. in Herb. T. C. D.)

Fronds very dense, one to two inches in diameter, fastigiate. *Filaments* rather thicker than human hair below, attenuated to the extremity, many times regularly dichotomous, the lower forks distant and rather patent, the upper successively closer and (except in var. *β*) more erect; the apices forked and slightly forcipate, subobtuse. *Nodes* coated with a band of cells, not swollen, sometimes constricted; lower internodes hyaline or occasionally striated with coloured, cobweb-like filaments which run through the walls, now and then anastomosing; upper inter-

nodes very short, not swollen, except the fertile ones. *Favellæ* lateral on the upper branches, not on lateral ramuli, subtended by two or three ramuli which at first are short, but afterwards lengthen and divide dichotomously, and then the favellæ seem sitting in a nest of branches. *Tetraspores* large and very prominent, bursting singly or in clusters from the outer margin of the nodes, especially those of the upper divisions. *Colour*, a brownish purple. *Substance*, flaccid, adhering to paper. Our var. β is a very remarkable form, and at first I looked upon it as a distinct species, but a further comparison of numerous specimens leads me to regard it as being merely an extreme variety. I have received it from several correspondents.

The reference to Agardh, whose plant comes from the Baltic Sea, requires confirmation, as I have seen no authenticated specimen. As a species our American plant is allied to *C. diaphanum*, from which it differs in size and in the mode of fruiting; and to *C. fastigiatum* and *tenuissimum*, from which the shorter internodes, unswollen nodes and more robust filaments separate it.

Plate XXXIII. B. *Fig.* 1. Ceramium *arachnoideum*, β *patentissimum;* the *natural* size. *Fig.* 2, part of a branch, *magnified*. *Fig.* 3, some of the nodes and internodes, highly *magnified*.

9. Ceramium *byssoideum;* filaments exceedingly slender ($\frac{1}{600}$ of an inch in diameter), soft, dichotomous; forks distant below, approximate above, the branches erecto-patent with acute angles; the upper branches having a few level-topped, forked, lateral ramuli; internodes hyaline, those of the principal stems six or eight times as long as broad, of the lesser thrice as long as broad, of the ramuli very short; internodes banded, definite, swollen, especially the upper ones; fruit unknown.

Hab. Parasitical on Gorgoniæ, at Key West, *W. H. H.* No. 77. (v. v.)

Tufts about an inch high, exceedingly soft. *Filaments* of almost cobwebby fineness, repeatedly and pretty regularly dichotomous, the axils all narrow and angles acute. Lateral ramuli on my specimens few. *Nodes* of the ramuli greatly swollen, bead-like, much thicker than the internode; those of the older branches less so, dark purple. *Colour* of the tuft rather pale.

This is by much the most slender of the genus. *Cer. gracillimum*, when placed beside it on the table of the microscope, looks large and coarse in comparison; nor is there the difference in diameter between the main branches and the ramuli, so observable in that species.

IV. PTILOTA. *Ag.*

Frond cartilaginous, compressed, two-edged, decompound, pectinato-pinnate, distichous, opaque, having an articulated, monosiphonous axis enclosed in a thick

cortical stratum of cells ; the inner cells of the cortical layer roundish, the outer minute, coloured. *Favellæ* terminal on the lesser ramuli, involucrated with numerous ramelli, containing within a hyaline periderm, numerous angular spores. *Tetraspores* on the ultimate pinnules, external, sessile, solitary or aggregate, formed each from an internode of the ramulus, roundish, triangularly divided.

A beautiful genus, strongly marked by its decompound-pinnate, distichous, inarticulate, or, rather, internally articulate fronds, which are of larger size, firmer texture and more opaque than in most other genera of this Order. All are branched on a pinnate model. In some the pinnæ and pinnulæ are regularly alternate throughout the branches and lesser divisions. In others they are as regularly opposite ; but among those with opposite pinnæ two varieties of ramification must be carefully distinguished. In some the opposite pinnæ are of the same nature, either of equal length and exactly similar, or one longer than the other, a longer and shorter pinna alternating regularly at each side of the rachis. In others, the opposing pinnæ are of different natures ; one of them phyllodium-like, always remaining unchanged after having once been formed, either entire, serrate or pectinate ; the other branch-like, pinnately-compound, at first shorter and simpler, afterwards lengthened and decompound in similar manner to the larger branches of which it is a pinna. The pinnæ opposite the phyllodia are often abortive or little developed ; whence arises an irregularity of ramification in most species. Often too they are very much reduced in size and converted into racemes of fructification.

Sect. 1. Diversifoliæ : *Pinnæ opposite, of different nature, one leaf-like undivided, the other (sometimes obsolete) branch-like, pinnatedly-compound.*

1. Ptilota *densa*, Ag.; frond plano-compressed, two-edged, decompound pinnate; pinnæ opposite, unlike ; one undivided, falcate, inciso-pectinate along its outer edge; the other compound, either lengthening out into a branch, or minute and ramuliform ; branches linear, densely set with the falcate pectinifid pinnæ and opposing minute multifid ramuli ; tetraspores in oblong glomerules alternating with the pinnulæ of the multifid ramuli. *J. Ag. Sp. Alg.* 2, *p.* 98. *Ptilota pectinata*, *Harv. in Beech. Voy. p.* 164. (Tab. XXXII. B.)

Hab. California, *Lay and Collie.* (v. s. in Herb. T. C. D.)

Frond several inches long, half a line in diameter, more or less compressed, decompound-pinnate, but very irregular in the development of its major pinnæ, though perfectly regular in the system of construction. Sometimes the major pinnæ are closely set and furnished with a second or third series also closely placed together ; sometimes (as in the specimen we have figured) they are widely distant and very unequal in length. Both the larger and lesser branches are opposed, at

their insertion, to falcate, incurved, leaf-like ramuli, a line or two in length, pectinate or deeply inciso-dentate along the outer edge. Similar distichous pinnæ border all the branches at distances of a line or two apart, alternating with each other, but opposing minute, multifid ramuli of equal length or very much shorter. These ramuli, carelessly examined, appear to be mere heads of densely crowded divaricato-multifid ramelli ; but are really composed on the same pinnated type as the rest of the frond, one pinnule being falcate and pectinate, the other pinnato-multifid, or if fertile, altered into a glomerulus of tetraspores. *Colour*, a full red, brownish when dry. *Substance* rigid, not adhering to paper.

A very remarkable and distinct species. I have examined an authentic fragment of Agardh's *P. densa*, preserved in Sir Wm. J. Hooker's Herbarium, and find it to agree perfectly with my more recently named *P. pectinata*. The latter name is therefore suppressed.

Plate XXXII. B. *Fig.* 1. Ptilota *densa ;* the *natural* size. *Fig.* 2, portion of a branch, with pectinate pinnæ, and opposing multifid, fertile ramuli ; *fig.* 3, a ramulus, with clusters of tetraspores ; *fig.* 4, tetraspores ; the latter figures more or less *magnified.*

2. Ptilota *hypnoides*, Harv. ; frond plano-compressed, two-edged, decompound-pinnate ; pinnæ opposite, unlike ; one undivided, leaf-like, lanceolate or ovato-lanceolate, acute, very entire ; the other elongated, pinnated with similar lanceolate acute pinnæ opposing ramuliform processes ; tetraspores aggregated in oblong glomerules, alternating with the pinnules of the lesser branches. *Harv. in Bot. Beech. p.* 164. *J. Ag. Sp. Alg.* 2, *p.* 97. *Kütz. Sp. Alg. p.* 670. (Tab. XXXII. A.)

Hab. California, *Messrs. Lay and Collie.* (v. s. in Herb. T. C. D.)

Fronds six to eight inches long, or probably much more, half a line in diameter at the base, compressed, two-edged, decompound-pinnate ; the primary branches of very unequal lengths, long and short intermixing together, closely pinnated throughout at distances of a line or two. One of the pinnæ is a simple, leaf-like, lanceolate or ovato-lanceolate, acute ramulus, a line in length, never altering with age ; the opposite pinna is a branchlet which is either abortive and rudimentary, or lengthens out into a branch which is closely pinnated with lanceolate leaf-like pinnules (like those of the larger branches) opposed to minute, pinnulated branchlets of their own length or shorter. These latter occasionally elongate, and are compounded in a similar manner to the larger branches ; and thus the frond continues to be developed. When fertile, however, they remain short, and consist then of lanceolate pinnellæ alternating with stalked, oblong clusters of tetraspores. *Colour*, a rosy purple. *Substance*, cartilaginous and firm. In drying, it does not adhere to paper.

A beautiful species, and perhaps not rare ; but as yet very few specimens have found their way to Europe. It was first found by Hænke, whose specimens were

confounded by the elder Agardh with *P. asplenioides*, from which this species is abundantly distinct.

Plate XXXII. A. *Fig.* 1. Ptilota *hypnoides ;* the *natural* size. *Fig.* 2, portion of a larger and lesser branch, with fertile ramuli ; *fig.* 3, a fertile ramulus, with oblong clusters of tetraspores ; *fig.* 4, tetraspores ; *fig.* 5, transverse section of the base of the stem ; the latter figures more or less highly *magnified.*

3. Ptilota *asplenioides*, Ag. ; frond plano-compressed, two-edged, decompound-pinnate ; pinnæ opposite, unlike ; one undivided, serrulated, the other (abortive or) pinnately parted ; pinnulæ erecto-patent, decurrent, scymitar-shaped, incurved, acute, serrulate, areolate ; fruits marginal, supra-axillary, the tetraspores in dense, roundish, pedicellate glomeruli ; the favellæ involucrate, the branches of the involucre pinnellated with articulate, single-tubed ramelli. *J. Ag. Sp. Alg.* 2, *p.* 98. *Rhodocallis asplenioides*, *Kütz. Sp. Alg. p.* 674. *Fucus asplenioides*, *Turner*, *Hist. Fuc. t.* 62. *Esper. Ic. t.* 147.

Hab. Northern Pacific Ocean. Prince William Sound, Russian America, *Mr. Menzies.* (v. s. in Herb. T. C. D.)

Frond twelve to eighteen inches long, a line or more in breadth, with a strongly compressed stem, which is slightly winged above, two-edged below, very firm, opaque and cartilaginous in its lower part, gradually flatter and thinner toward the summit, single or divided into several principal branches or secondary fronds. The mode of branching is pinnate ; the pinnation repeated many times in large specimens after a uniform system, which is easily understood by examining one of the lesser branches of an old plant, or the apex of the main stem in a younger plant. Such branch has a plano-compressed rachis, distichously pinnate with normally opposite, but very different looking pinnæ. One pinna of each pair is undivided, about two lines long and half a line wide, cultriform, acute, erecto-patent and somewhat incurved, more or less distinctly serrated or serrulated, rarely nearly entire, its lamina vertical (in the same plane as the flat rachis) the lower edge decurrent or gradually fining off into the rachis. The opposing pinna when developed, for it is frequently abortive, is many times longer and is again pinnated on a similar plan. In the subsequent divisions of the frond the undivided-cultriform pinnæ and pinnules are often alone perfected, and these constantly alternate with each other ; the place of the pinnately-parted pinnæ being merely indicated by a minute ramulus or even reduced to a rapidly obliterated process. In such specimens the frond seems alternately pinnatifid, as figured and described by Turner, but the examination of a young branch shows that this is a deceptive appearance. The pinnæ and pinnulæ are coated with a uniform surface of small polygonal cells. When held between the eye and the light, and examined with a pocket lens, a slender medial line (the axial filament) is seen running through the frond, and sending off branches to each pinnule ; this line of cells, in the pinnule, running nearer to the upper than to the inferior margin. The serratures of the margin are very variable

in different specimens. *Fruit* of both kinds is borne along the margin, either on the rachis, above the axil of the pinnules, or, very frequently, along one or both edges of the pinnule itself. The *tetraspores* are densely crowded in little pedicellate heads. The *favellæ* are likewise stalked, and surrounded by involucral pinnated ramelli. *Colour*, a dark brownish red. *Substance*, cartilaginous. It does not adhere to paper in drying.

Discovered by Mr. Menzies on the North West Coast of America, but seemingly much more common in North Eastern Asia, particularly in Kamtschatka, from which country I possess several specimens.

4. Ptilota *Californica*, Rupr. ; frond plano-compressed, two-edged, virgate, decompound-pinnate ; pinnæ and pinnulæ opposite, unlike; one undivided denticulate or serrate, the other (abortive or) pinnately parted; pinnulæ broadly sword-shaped, slightly narrowed at base, erecto-patent, incurved, acute, more or less denticulate, especially toward the apex, areolated with cells; fruits marginal, the tetraspores (?) in densely paniculate, pedicellate glomeruli alternating with the pinnulæ; favellæ similarly placed, involucrate, the branches of the involucre entire or dentate. *β concinna;* pinnules sharply inciso-serrate.

Hab. North California, *Wosnessenski!* Golden Gate, *Capt. Pike!* Var. *β*, with the preceding, *Capt. Pike.* (v. s. in Herb. T. C. D.)

Fronds six or eight inches long, repeatedly pinnate, the primary and secondary pinnæ long and virgate, the rest short, ramuliform. Branches strongly compressed, half a line wide, erecto-patent, much attenuated at their insertion. *Pinnulæ* between lanceolate and sword-shaped, slightly narrowed, not the least decurrent at base, incurved, acute, sometimes almost entire, but generally sharply denticulate, or unequally serrate. *Favellæ* pedicellate, marginal, solitary or numerous in the spaces between the pinnules. *Tetraspores* appear to occupy the same place, but I have not seen perfectly formed ones: in my specimens there are minute, paniculately branched glomeruli, but whether intended for antheridia or tetraspores I have not determined. *Colour*, dark purple-red.

This species is very nearly allied to *P. asplenioides*, from which it chiefly differs in the narrower, not decurrent pinnules, evidently narrowed at the base. It differs from *P. serrata* more in its virgate habit and dark colour than by any very precise characters, unless that noticed in the glomeruli of tetraspores may be constant. The serratures of the pinnulæ are exceedingly variable, each of Capt. Pike's specimens differing in the degree of incision.

5. Ptilota *serrata*, Kütz. ; frond plano-compressed, two-edged, decompound-pinnate ; pinnæ and pinnulæ opposite, unlike ; one undivided serrated, the other (abortive or) pinnately parted ; pinnulæ broadly subulate, very patent, acute, sharply serrated, especially on the outer edge, areolated with cells; fruits marginal,

the tetraspores in conical, pedicellate glomeruli, alternating with the serrated pinnulæ ; favellæ similarly placed, involucrate, the branches of the involucre entire or coarsely toothed, cellular. *Kütz. Bot. Zeit.* 1847, *p.* 36. *J. Ag. Sp. Alg.* 2, *p.* 96. *Ptilota plumosa β asplenioides*, *Lyngb. t.* 9, *f.* 2. (*Excl. Syn.*)

Hab. Pacific Coast at Sitcha, *Ruprecht.* Greenland and Newfoundland, *J. Agardh.* Arctic Coast, *Sir John Richardson.* Halifax, *W. H. H.* Boston Bay, *Dr. Asa Gray*, *Mrs. Mudge*, *Mr. Emerson*, *W. H. H.*, &c. (v. v.)

Frond four to six inches long, the stem plano-compressed, half a line in breadth, distichously much branched, the branches decompound-pinnate, all divisions of the frond very patent, almost issuing at right angles. *Pinnæ* and pinnulæ of every series exactly opposite, except by accidental suppression, but of different size and aspect: one of each pair a line long, horizontal, broadly subulate, sharply serrated especially on the outer edge, acute, seldom lengthening and never much lengthened, in the older parts of the frond generally broken, or worn : the other pinna elongate, pinnated and lengthening out into a branch which becomes again compounded by its pinnæ also lengthening in a similar manner. In this way the frond finally consists of several series of short-serrated, and of longer-pinnated opposing pinnæ. The *favellæ* are formed in the apices of the pinnated (or compound) ramuli, which are then abbreviated to a line or two in length ; the branches of their involucre are subulate, either entire or with three or four coarse teeth. *Tetraspores* in dense conical heads, also formed from suppressed branches, alternating with the serrated pinnæ. *Substance*, cartilaginous. *Colour*, a deep, full red, becoming brighter in fresh water. In drying, it does not adhere to paper.

This has the colour, size, and general aspect of *Pt. plumosa*, with which I have been hitherto accustomed to unite it, nor am I very certain that the characters here pointed out as distinguishing it are to be relied upon as sufficient. The strongest character will perhaps be found in the tetrasporic fruit : that in the ramification is, I fear, less constant. The elder Agardh at one time, and Lyngbye both referred it to *Pt. asplenioides*, from which it is readily distinguished. Agardh afterwards made it a variety of *Pt. plumosa*. Kützing in 1847 first gave it a specific name, but subsequently, in 1849, reduced it again as a variety, under *Pt. plumosa*. Professor J. Agardh, however, restores the species, and points out with his usual acumen the characters by which it may be known from *Pt. plumosa*.

These characters, so far as they depend on ramification, are not perfectly satisfactory to me, for I find the serrated ramuli of *Pt. serrata* showing an occasional disposition to lengthen into branches ; and again, on *Pt. plumosa* one of the opposing ramuli is, in the younger branches, frequently abortive, in which case the ramuli are alternately unequal, as in *Pt. serrata*. If the ramulus which is formed were always clearly pinnated as it ought to be in *Pt. plumosa*, there would be no doubt of the validity of *Pt. serrata ;* but though this is commonly the case, yet I have specimens of the former species in which slightly serrated, or nearly entire ramuli alternate with pinnated ones in some parts of the frond. Both species occur together in Norway, but *Pt. serrata* has not yet been found in Britain. Almost all the

American specimens before me are clearly referable to *Pt. serrata;* nevertheless, Sir John Richardson collected on the Arctic coast both the true *Pt. plumosa* and *Pt. serrata.* Finally, and this is rather puzzling, I have a specimen from Prince Edward's Island somewhat intermediate in character between both species, but having the preponderance in favour of *Pt. plumosa*, and yet being unlike any European specimen of that species which I have seen.

On the whole I am disposed, for the present, to adopt this species, considering it more critically characterised in doubtful cases by its fructification than by its ramification.

Sect. 2. Similifoliæ : *Pinnæ opposite, of similar nature, either both of the same length or one longer, one shorter than the other ; the longer alternating on the rachis.*

6. Ptilota *plumosa*, Ag. ; frond plano-compressed, two-edged, decompound pinnate ; pinnæ and pinnulæ opposite, similar in form, but one frequently shorter than the other, the shorter pinna simply pinnate, not altering ; the longer developing into a branch, becoming compound ; ultimate pinnated ramuli, by suppression of the opposing ramuli, frequently alternate ; pinnellæ subulate, areolated with cells, acute ; favellæ formed either on the pinnæ or pinnellæ, involucrate, the branches of the involucre subulate, entire ; tetraspores on marginal processes of the pinnellæ. *J. Ag. Sp. Alg.* 2, *p.* 96. *Harv. Phyc. Brit. t.* 80. *Fucus plumosus, L.—Turn. Hist. t.* 60. (*excl. var. β.*), *E. Bot. t.* 1308.

Hab. Parasitical on the stems of *Laminariæ*, &c. Prince William's Sound, North West America, 1787, *Mr. Menzies !* Arctic Sea Coast, *Sir John Richardson !* Prince Edward's Island, *Dr. Jeans.* (v. v.)

Very like the preceding in aspect, and only to be known by the characters detailed in the above descriptions and remarks. The different position of the *tetraspores* is perhaps the most valid character.

The *true Pt. plumosa* is of very rare occurrence in America. That which commonly passes under this name, in collections made to the North of Cape Cod, is *Pt. serrata ;* that in those made to the south of that head-land is *Pt. elegans.* I have examined and compared specimens of the true *Pt. plumosa* from the above localities, with European individuals, and consider them specifically identical.

7. Ptilota *elegans*, Bonnem.; frond flaccid, filiform, terete, decompound-pinnate; pinnæ and pinnulæ opposite, similar, both pinnately parted, the opposing one either of equal size or one smaller than the other ; the younger pinnæ and all the ultimate pinnules articulate, composed of a single series of large, sub-quadrate cells, obtuse, linear (not attenuated); tetraspores terminating the ramuli, at length polysporous; favellæ binate, naked, or sub-involucrate, on the pinnæ. *Bonnem. Hydr. p.* 22. *Kütz. Phyc. p.* 378. *J. Ag. Sp. Alg.* 2, *p.* 94. *Pt. sericea, Harv. Phyc. Brit. t.* 191.

Hab. Generally on rocks, rarely on the stems of the littoral Fuci. Boston Bay, at Beverley, *W. H. H.* Newport, *Prof. Bailey*, *Mr. Olney*, *&c.* Squan Beach, New Jersey, *Miss Morris.* (v. v.)

Fronds three to six inches long and as much in the expansion of the branches, as thick as hog's bristle at the base, attenuated upwards, terete, not compressed or two-edged, decompound-pinnate; the larger branches irregularly alternate and of unequal length, the lesser close together, opposite, either of equal length or one of each pair short, the other longer and more compound. The lesser branches are linear-oblong or somewhat obovate in outline, their upper subdivisions being successively longer than the lower; they are twice or thrice pinnated. All the divisions, except by suppression, are strictly opposite, but towards the extremities one of the opposing pinnæ is often imperfectly formed. The pinnules and all the younger pinnæ are articulate, composed of a single row of large, quadrate or slightly oblong cells; they are slightly incurved, of equal diameter throughout, very obtuse, and those along the outer edge of the rachis are generally longest, and are frequently pinnellated at the tips. *Tetraspores* borne on the tips of the ultimate pinnules, at first containing four sporules, afterwards eight or a larger number, when they resemble favellæ. *Colour* a brownish purple, rather dark; a clear purple-lake under the microscope. *Substance* soft. In drying, it closely adheres to paper.

A smaller and softer plant than any of the preceding and readily known by its articulated pinnules.

V. CROUANIA. *J. Ag.*

Frond filiform, gelatinous, nodoso-moniliform, alternately decompound, consisting of an articulated, monosiphonous primary filament (or axis) emitting at the nodes densely whorled, minute, dichotomo-fastigiate, gelatinous, free ramelli. *Favellæ* near the ends of the branches sub-solitary, affixed at the base of the whorled ramelli and covered by them, containing, within a hyaline periderm, numerous roundish spores. *Tetraspores* fixed at the base of the ramelli, partly hidden by them, roundish, triangularly parted or transversely bi-parted.

Very flaccid, gelatinous Algæ of small size with moniliform branches, resembling in habit the species of the fresh water genus *Batrachospermum*. In artificial character they nearly coincide with the species of *Halurus*, but differ essentially in the position of the fructification, and in the substance of which the frond is composed. The young branches are nearly cylindrical, the whorled ramelli forming a scarcely interrupted periphery. As the frond increases in age, the whorls are

removed further apart by the elongation of the internodes, and the branches become beaded at intervals.

1. Crouania *attenuata*, J. Ag.; frond attenuated upwards; the tetraspores solitary, triangularly parted. *J. Ag. Sp. Alg.* 2, *p.* 105. *Harv. Phyc. Brit. t.* 106. *Callithamnion nodulosum*, *Kütz. Sp. Alg. p.* 651. (Tab. XXXI. D.)

Hab. Key West, *W. H. H.*, 68, 69; *Dr. Blodgett*, 56, 61. (v. v.)

Fronds tufted, one to two inches long, capillary or setaceous, irregularly branched; branches lateral, alternate or secund, or sub-dichotomous, more or less divided; the lower ones moniliform, the upper more and more cylindrical from the greater closeness of the whorls of ramelli; the apices attenuated to a fine point. *Colour*, a dull, dark purple.

The Key West specimens are much infested with calcareous matter and do not recover well after having been dried. The magnified sketch in our figure was made on the spot, from fresh specimens.

Plate XXXI. C. *Fig.* 1. Crouania *attenuata;* a tuft, the *natural* size. *Fig.* 2, a branch; *fig.* 3, one of the ramelli from the same; *fig.* 4, occasionally trichotomous apices of a ramellus; the latter figures more or less highly *magnified.*

VI. HALURUS. *Kütz.*

Frond cartilaginous, filiform, articulated, monosiphonous, irregularly branched; branches clothed at the nodes with short, incurved, dichotomous, whorled ramuli. *Favellæ* generally several in a cluster, borne on the apex of a shortened branch, and sub-tended by a whorl of involucral ramuli, containing, within a hyaline periderm, numerous angular spores. *Tetraspores* attached to the interior side of the branches of an involucre formed of dichotomous ramelli, numerous, spherical, triangularly parted.

This genus has been separated by Kützing from *Griffithsia*, with which it nearly but not exactly agrees in the fructification, and from which it differs in external habit. The plants of the present group have, except in colour, very much the appearance externally of the *Cladostephi.*

1. Halurus *equisetifolius*, Kütz.; frond irregularly branched, the branches directed to every side; whorled ramuli incurved, forked or dichotomous, densely set, their

articulations four to eight or twelve times as long as broad. *Kütz. Sp. Alg. p.* 662. *J. Ag. Sp. Alg.* 2, *p.* 90. *Griffithsia equisetifolia*, *Ag.—Harv. Phyc. Brit. t.* 67. *Conferva equisetifolia*, *E. Bot. t.* 1479. *Dillw. t.* 54.

Hab. (A specimen sent to me by Mr. Hooper, of Brooklyn, without locality marked; *W. H. H.*)

Stems six or eight inches long, robust, much and very irregularly branched; the branches alternate or fascicled, undivided, but set with one or more series of lateral branches. All the parts of the frond are clothed with ramelli. On the older parts of the stem and branches these form an irregular shaggy coating; but on the younger portions they are regularly whorled at the nodes, once or twice or many times forked, imbricated, with the apices generally incurved. The articulations vary much in length in different specimens. *Colour*, when recent, a fine dark, crimson-lake. *Substance* firm. It gives out a carmine tint when plunged for a short time in fresh water.

I regret that I cannot say from what part of the American Coast Mr. Hooper procured this plant, of which I have as yet seen but a small fragment; but it is sufficient for identification.

VII. GRIFFITHSIA. *Ag.*

Frond filiform, dichotomous, articulated, monosiphonous, naked. *Favellæ* generally several in a cluster, subtended by a regular involucre formed of numerous incurved ramelli, sessile or pedunculate, containing, within a gelatinous periderm, numerous angular spores. *Tetraspores* contained within an involucre formed of incurved ramelli, spherical, attached to the inner faces of the ramelli, at length triangularly parted.

A large genus of rose-red or crimson, filiform, articulated Algæ of a delicately membranaceous or sub-gelatinous substance, soon decomposing in fresh water. The frond consists of a single series of large, elongated cells, with very transparent walls, forming a broad limbus to the brilliantly coloured bag of endochrome contained within. The branching is on a dichotomous model, occasionally varied by the production of lateral branches, or converted partially into a trichotomous type. The species are dispersed through the Northern and Southern Hemispheres. I can claim only the following as yet for the North American Flora.

1. Griffithsia *corallina ?* Ag.—*J. Ag. Sp. Alg.* 2, *p.* 78, *&c.* Var. β *globifera ;* filaments capillary, the lower articulations many times longer than broad, but slightly swollen ; the upper and terminal ones inflated, pyriform or globose. *Griffithsia globifera, Harv. MS.* (Tab. XXXV. A.)

Var. γ, *tenuis ;* of small size, all the articulations slender, but slightly swollen upwards, the terminal ones attenuated.

Hab. Vars. β and γ on *Zostera*, at Greenport, Long Island, *Prof. Bailey* and *W. H. H.* Providence, *Mr. Olney.* New Bedford, *Dr. Roche.* Port Jefferson, *Mr. Lounsbury.* Key West, (a fragment only) *W. H. H.* (v. v.)

In var. β the frond is capillary or setaceous, two to three inches high, densely tufted, many times dichotomous, more or less fastigiate, the upper branches sometimes, by abortion, alternate or secund ; the lower axils patent, the upper more erect. *Internodes* more or less swollen upwards, the lower ones many times longer than their diameter and little swollen ; the upper shorter, either pyriform or elliptical ; the terminal very frequently globose, much inflated, twice or thrice the diameter of that immediately below it. *Favellæ* sessile on the apex of an internode of the branches, especially of the upper ones, occupying the position of a suppressed arm of a dichotomy, subtended by a few short ramelli, one or more favellæ in each involucre. *Colour* rose-red, rapidly discharged in fresh water. *Substance* soft, gelatinoso-membranaceous, closely adhering to paper in drying.

In var. γ, the frond is one to four inches high, the lower articulations very long, some of them cylindrical, others slightly pyriform ; the upper articulations more frequently pyriform, and the terminal ones slender, the branches often tapering to a fine point. I have not seen fruit on this variety.

These two varieties appear distinct enough *on paper*, not merely from each other, but from the common European state of *Griff. corallina ;* and at first I had set aside var. β as a species, characterised by the terminal, vesicular cell. Afterwards on gathering a large number of specimens of both forms at Greenport, where they are common in August, I found some that had the peculiarities of var. β and γ combined on the same frond, and others that approached in essential characters to the ordinary *G. corallina.* None, however, that I have seen from America can be said to be absolutely similar to those from Europe, as all, however much they may put on the characters, are much more slender than any European specimens I have seen. Possibly future observations may require the establishment of a new species for these American varieties.

Plate XXXV. A. *Fig.* 1. Griffithsia *corallina*, var. *globifera*, the *natural* size. *Fig.* 2, a portion of the frond *magnified. Fig.* 3, apex with favella ; and *fig.* 4, spores ; highly *magnified.*

VIII. CALLITHAMNION. *Lyngb.*

Frond filiform, branched, articulated, monosiphonous, the stem and branches (in many species) at length rendered opaque by the development of decurrent filaments in the walls of the primary cells; ramuli always articulated, monosiphonous. *Favellæ* generally binate, axillary or sessile on the branches, naked or nearly so, containing, within a hyaline periderm, numerous angular spores. *Tetraspores* naked, sessile or pedicellate, distributed along the ramuli, oblong or globose, triangularly or cruciately parted.

A very large genus of beautiful Algæ, sometimes minute, never of large size, rarely exceeding six inches in length. The fronds in the least developed species are but slightly branched, a line or two long, parasitical, forming a down-like covering to the plants on which they grow. Others, a little more perfect, grow on rocks, on which they form dense, cushion-like tufts, from a quarter inch to an inch in height. Some few have their smaller branches and ramuli dichotomously multifid. The greater number, however, are branched on a more or less regularly pinnate type; the pinnæ and pinnulæ either opposite or alternate, rising singly or in pairs from the upper extremity of every internode. In some species every part is exactly distichous: in others the lower branches and larger divisions spread to all sides, while the lesser ones are distichous: and again, in others all the branches and their subdivisions spread in every direction. In the smaller species the whole frond is pellucidly articulate, composed of a single series of thick-walled, endochromatic cells arranged end to end; and such is the structure of the young frond in all. In the larger species, as the frond increases in age, filaments, originating in the bases of the branches, begin to be developed longitudinally in the substance of the walls of the frond. At first they are few and short, afterwards numerous and prolonged in a downward direction, and at last they completely fill the wall, rendering it opaque and concealing the articulations completely. In the strongest growing species the walls become at length very much thicker than the enclosed tube, and completely filled with such decurrent filaments.

The species are often very difficult of determination, forming numerous and most puzzling varieties. They often require very copious materials to work on before they can be well understood, and in some cases I labour under the disadvantage of having received imperfect materials. Some of the following species present so many forms, that before I had compared together very extensive suites, I was disposed to separate into four or five what I now regard as a single species. And though my friend Prof. Agardh has considerably curtailed the species as described by other writers, I fear that of the sixty-three which his work still admits, several should be struck off. To come to right conclusions on this point, the species should be studied on the sea shore, before the specimens have been dried, for the characters of many are of so delicate a nature, that they are apt to be saved or lost, according as the

specimen is well or ill dried. For the convenience of easy reference, I divide the American species into the following six sections :—

Sect. 1. Fruticosa : *Frond shrub-like, the stem and branches more or less filled with veins, imperfectly articulate. Ramuli pectinate or pinnate, the pinnæ alternate or secund.*

1. Callithamnion *Pikeanum ;* frond robust, fruticose, with an undivided, opaque stem, set with alternate, similar branches directed to every side ; branches alternately decompound, opaque, the lesser divisions densely beset on all sides with minute, imbricated, articulated ramuli ; ramuli divaricate, pectinate or bi-pectinate on the outer side (the naked side directed to the rachis), the ultimate divisions spreading at right angles, subulate, sub-acute ; articulations of the ramuli once and half as long as broad ; tetraspores tri-partite, sessile, one or more together on the ultimate ramuli.

Hab. Golden Gate, California, *Capt. Nicholas Pike.* (v. s. in Herb. T. C. D.)

Frond solitary ? *Stem* four to five inches high, half a line in diameter at the base, undivided, slightly attenuated upwards, opaque, set with similar, opaque, alternate branches, which again bear a second or third series of similar, but smaller branches. *Branches* directed to every side, the larger ones either naked or clothed with minute, hair-like ramuli, the lesser ones very densely set on all sides with minute, multifid ramuli, one to two lines in length. These ramuli alone are pellucidly articulate, the articulations once or twice as long as broad. They are set at right angles to the branches from which they spring, but are curved or arched inwards, so as to present to the branch the concave face, which is bare of ramelli ; the convex or outward face being pectinated with horizontally patent or divaricated, spine-like, simple or again pectinellated ramelli. *Tetraspores* roundish, triangularly-parted, sessile, or borne on the ultimate divisions of the ramuli. *Favellæ* I have not seen. The *colour* is a dark, vinous purple. The *substance* is firm and rather rigid. It imperfectly adheres to paper in drying.

This species is very different from any American one known to me, but is nearly related to the European *C. Arbuscula*, and still more closely to the South African *C. purpuriferum*, J. Ag. ; but appears to be distinct from both. It is a stronger growing plant than *C. Arbuscula*, with more squarrose and thicker ramuli. From *C. purpuriferum* it differs in colour, in the ramification of the ultimate ramuli, in the much greater opacity of the stem and branches, the structure of the tetraspores, &c. I have pleasure in bestowing on it the name of Captain Nicholas Pike, of Brooklyn, an ardent student of marine plants, to whom I am indebted for a very interesting collection of Californian Algæ, among which was this species.

2. Callithamnion *tetragonum*, Ag.; frond ultra-setaceous, shrub-like, with a per-

current stem and pyramidal outline ; branches lateral, directed to every side, simple or alternately decompound, densely clothed with short, pinnato-multifid, fastigiate plumules; ramuli divaricate, subulate; articulations of the stem and larger branches veiny, once or twice as long as broad, of the ramuli about twice as long as broad, cylindrical or contracted at the nodes ; tetraspores very minute, tripartite, near the tips of the ramuli. *J. Ag. Sp. Alg.* 2, *p.* 53. *Harv. Phyc. Brit. t.* 136. *Phlebothamnion tetragonum, Kütz. Sp. Alg. p.* 654. *Callithamnion brachiatum, Harv. Phyc. Brit. t.* 137. *Conferva tetragona, Dillw. Conf. t.* 65. *E. Bot. t.* 1690.

Hab. Newport, Rhode Island, *Mr. Olney, Dr. Durkee.* Narragansett Pier, *Mr. Hunt.* Seaconnot, *Mr. C. Congdon.* Greenport, *Prof. Bailey.* (v. v.)

Fronds three to four inches high. *Colour*, a fine lake or red brown. *Substance* gelatinoso-cartilaginous.

The American specimens here described are not quite so robust as the European plant, but some of them are in other respects very similar. Others, again, show a tendency to pass into *C. Baileyi*, and almost shake my opinion of the validity of that species ; and yet its *extreme* forms are so different from the *nearest* form of *C. tetragonum*, that I dare not, as species are at present understood, unite them.

3. Callithamnion *Baileyi*, Harv. ; frond setaceous, shrub-like, with a percurrent stem ; branches lateral, directed to every side, simple or alternately decompound, densely ramulose ; lesser branchlets spirally inserted, somewhat plumulate, or fasciculato-multifid, zig-zag ; ramuli alternate, subulate, incurved, acute ; articulations of the lower stem veiny, twice or thrice as long as broad, of the branches swollen at the nodes, thick-walled, without veins, three or four times as long as broad ; of the ramuli cylindrical, about thrice as long as broad; tetraspores solitary, elliptical, on the inner faces of the ramuli ; favellæ binate. *Harv. in Bail. list of Algæ, Sill. Journ. vol.* 4, 2*d. Ser., p.* 38. (Tab. XXXV. B.) Var. *β boreale ;* stem pellucidly articulate, its medial articulations four or five times as long as broad, those of the branches cylindrical, and of the ramuli longer than in var. *α*. Var. *γ Rochei ;* more slender than usual and very plumose ; the ramuli elongate, patent, crowded at the ends of the branches. Var. *δ squarrosum ;* plumules short and little divided ; ramuli short, squarrose.

Hab. New Brighton, *Prof. Bailey.* Abundant in New York Bay, *Prof. Bailey. Messrs. Hooper, Pike, &c., W. H. H.* *β*, Boston Bay in various places, *Mrs. Mudge, Dr. Durkee, Miss Brewer, &c.* *γ*, New Bedford, *Dr. Roche.* *δ*, Red Hook, *Mr. Hooper.* (v. v.)

Fronds tufted or solitary, shrub-like. *Stems* as thick as hog's bristle, two to three inches long, generally undivided and closely beset on all sides with similar, undivided, long lateral branches, the lowest of which are longest, the rest successively shorter, so that the outline of the frond is pyramidal. In luxuriant specimens

these primary branches bear a second or third series of similar lesser branches. *Branches* densely set with short, spirally inserted branchlets, the lowest of which are simple or bifid, the upper more compound or somewhat plumulate ; the *plumule* either pinnate or bi-pinnate, the upper pinnules being frequently pinnellate. *Ramuli* subulate, mostly incurved, tapering to a fine point. *Articulations* variable in length; those of the main stem generally veiny, sub-opaque ; those of the branches destitute of veins except in very old specimens, swollen at the nodes, with narrow endochrome and thick, hyaline walls ; those of the ramuli from three to four or five times as long as broad. *Tetraspores* mostly solitary, near the middle of the ramuli. *Favellæ* in pairs on shortened plumules. *Colour*, a fine, dark red. *Substance* rather soft. It closely adheres to paper in drying.

The original specimens received from Prof. Bailey appeared, when I first examined them, to constitute a well marked species, readily distinguishable from all others ; and specimens sent to me from various correspondents, and others collected by myself at New York, agree with them in all essential characters. But many other specimens have also reached me which vary greatly from the type, especially in the length of the articulations, and yet which are too closely connected with the first specimens to warrant their specific separation. In our var. *β boreale*, which is the common form of the species in Massachusetts Bay, the frond is more pellucid, of a brighter colour, with longer internodes. But the most delicately beautiful feathery specimens are those received from Dr. Roche of New Bedford, which are so unlike the New York plant, that but for the Boston variety just mentioned, I should hardly have ventured to unite them. Again, the most robust forms, with shortest joints, approach *inconveniently* near to *C. tetragonum*, from which species the more delicate ones appear widely different. Future observations may perhaps show that Dr. Roche's specimens should be separated ; but if this be done, what I now regard as a single species must be split into four or five.

Plate XXXV. B. *Fig.* 1. Callithamnion *Baileyi ;* the *natural* size. *Fig.* 2, plumule and part of lesser branch of the var. *β boreale ; fig.* 3, favellæ from the same ; *fig.* 4, part of stem of the normal variety (*a*); *figs.* 5 and 7, plumules from the same ; *fig.* 6, a ramulus, with tetraspores ; the latter figures more or less *magnified.*

Sect. 2 Rosea : *Fronds capillary or byssoid, densely tufted, articulated throughout, (the older parts of the stem veiny, but not opaque) decompound-pinnate ; pinnæ and pinnules alternate.*

4. Callithamnion *squarrulosum ;* frond setaceous, distichous ; stem and larger branches veiny toward the base, but visibly articulate throughout, percurrent, set with lateral, flexuous, alternate branches, which are naked or with a few squarrose ramuli below and alternately decompound beyond the middle ; secondary branches of unequal lengths, very patent, laxly set with alternate, simple, bifid or pinnulate divaricating, obtuse ramuli ; articulations four or five times as long as broad, the cell-walls thick and endochrome narrow.

Hab. Golden Gate, California, *Capt. N. Pike.* (v. s. in Herb. T. C. D.)

Frond two to three inches high, as thick as hog's bristle below, tapering to a capillary diameter above. *Stem* percurrent, slightly flexuous, set with alternate, distichous, sub-horizontal branches, the lowest of which are longest. General outline of the frond ovate. *Branches* flexuous, naked in the lower half or with a few squarrose ramuli, alternately branched beyond the middle ; the secondary branches of very unequal lengths, ziz-zag, simple or variously decompound, sometimes resolved into an intricate, thorny, bushy head. *Ramuli* all very patent, alternate, variously compound, some quite simple, some bifid or trifid, and some pinnulate, the pinnelli divaricating. *Stem* veiny below, but not opaque. *Articulations* of nearly uniform length in all parts of the frond, except toward the base of the stem. *Cell* walls remarkably thick. No fruit seen.

Of this apparently distinct species I have seen but a single specimen, and probably the specific character and description may require to be revised and corrected. Had the specimen come from the Atlantic Coast I should hardly have ventured to propose a species on such imperfect materials.

5. Callithamnion *Borreri*, Ag.; fronds densely tufted, capillary, pellucidly articulate to the base, pinnately or flabellately branched ; branches beset in their lower part with spirally inserted, mostly simple, elongate ramuli, distichously plumulate above ; plumules fan-shaped, bare of ramuli in the lower half, simply pinnate beyond the middle ; the pinnæ patent or incurved, not much tapered, obtuse ; articulations of the branches two to six times, of the pinnæ twice or thrice as long as broad ; tetraspores numerous on the inner face of the pinnæ. *J. Ag. Sp. Alg.* 2, *p.* 49. *Harv. Phyc. Brit. t.* 159. *Kütz. Sp. Alg. p.* 643. *Conferva Borreri, E. Bot. t.* 1741.

Hab. New Bedford, *Dr. Roche.* Newport and Newhaven, *Dr. Durkee.* Seaconnot, *Mr. Congdon.* New York, *Messrs. Walters, Hooper, Calverley, &c.* (v. v.)

Tufts one to three inches high, dense, sub-fastigiate. *Filaments* decompound from the base, the lower branches spreading to all sides, often of nearly equal length ; the lesser branches irregularly inserted, either naked in their lower half, or beset with long, simple, hair-like ramuli, distichously plumulate beyond the middle. The *plumules* are petiolate, or naked below, pinnate above. Pinnæ spreading, obtuse. *Articulations* throughout the plant (except rarely near the base of the stem) destitute of veins ; those of the stem very variable in length in different specimens, sometimes only twice or thrice, sometimes four to six times as long as broad ; those of the ramuli more uniform, and mostly contracted at the nodes. *Tetraspores* on the inner face of the ramuli, sometimes few, sometimes many.

More slender and softer than the common European form ; and had my attention been confined to Mr. Congdon's specimens I should possibly have described them as a

distinct species. But Dr. Roche's specimens above noticed seem to connect Mr. Congdon's with some European varieties of this variable species.

At Greenport, Long Island, I collected a *Callithamnion*, infested by parasites and otherwise in bad order, which at present I doubtfully refer to *C. Borreri*. These specimens are more robust than the other North American ones, but not more so than European states of the species, and despite some minor peculiarities I hesitate to pronounce them different. Possibly more perfect specimens would compel us to separate them.

6. Callithamnion *polyspermum*, Ag.; fronds densely tufted, capillary, much branched, pellucidly articulate nearly to the base, decompound pinnate; main branches either naked or ramulose below, distichously plumulate above; plumules linear or oblong in outline, simply pinnate; pinnæ incurved, obtuse, cylindrical, nearly equal in length, the uppermost sometimes pinnulate near the tips; articulations of the stem mostly veinless, three or four times, of the pinnæ twice or thrice as long as broad; tetraspores elliptical, solitary, or two or more together near the base of the pinnæ. *J. Ag. Sp. Alg.* 2, *p.* 48. *Harv. Phyc. Brit. t.* 231. *Phlebothamnion polyspermum*, *Kütz. Sp. Alg. p.* 653.

Hab. Hellgate, New York, *Mr. J. Hooper*. Jackson Ferry, *Messrs. Walters* and *Pike*. Sullivan's Island, Charleston, *Prof. L. W. Gibbes* and *W. H. H.* St. Augustine, Florida, *Prof. J. W. Bailey*. (v. v.)

Tufts two to three inches high. Filaments capillary, irregularly branched from the base, the main branches frequently naked below and distantly divided, their divisions decompound-pinnate or closely plumulate in the upper half. *Plumules* distichous, broadly oblong or linear, rounded at the top, scarcely petiolate, the lowest pinnæ generally springing from the second articulation counting from the base of the rachis; pinnæ simple, linear and obtuse, the upper ones not remarkably shorter than the lower. *Tetraspores* frequently solitary on the second or third joint from the base, elliptical, sometimes two or three or more on the same pinnule. *Favellæ*, near the ends of shortened plumules, in pairs. *Colour*, a fine purplish-red, given out in fresh water. *Substance*, soft, but not gelatinous. It closely adheres to paper in drying.

A variable species, allied on the one hand to *C. Borreri*, and on the other to *C. roseum*. The above description is taken exclusively from American specimens, which, though not strictly agreeing with the typical state, figured in *Phyc. Brit.*, are very similar to many specimens from the South of England; particularly to those from Plymouth Harbour.

7. Callithamnion *byssoideum*, Arn.; fronds densely tufted, of extreme tenuity, very flaccid and tender, pellucidly articulate nearly to the base, excessively

branched; lower branches irregularly divided, the upper decompound-pinnate and plumulate; plumules flexuous, distantly and rather irregularly pinnate, the pinnæ alternate or secund, slightly tapering, obtuse, often ramulose toward the point; articulations of the branches six or eight times, of the ramuli three to six times as long as broad; tetraspores elliptical, tripartite, secund, several on each pinna; favellæ binate. *J. Ag. Sp. Alg.* 2, *p.* 40. *Harv. Phyc. Brit. t.* 262. *Phlebothamnion byssoides, Kütz. Sp. Alg. p.* 657. *Callith. arachnoideum, Ag. Sp. Alg. p.* 181. Var. *β unilaterale;* of smaller size and still greater tenuity than the ordinary form; the branches and ramuli very frequently secund, the plumules irregular, sometimes alternately pinnate, sometimes secundly pectinate. *Cal. unilaterale, Harv. MSS. (not of Zanard.)* Var. *γ fastigiatum;* branches fastigiate, the lesser ones densely ramulose at the tips. Var. *δ Waltersii;* more rigid than usual, the upper branches distichously decompound-pinnate, ramuli remarkably patent.

Hab. New York Harbour, in several places from Hellgate to Port Hamilton, *Messrs. Hooper, Walters, Congdon, Calverley, &c.* Var. *β*, Massachusetts Bay, *Mrs. Mudge, Dr. Durkee, Miss Mitchell, Capt. Pike, &c.* Greenport, *Prof. Bailey, W. H. H. &c.* (v. v.)

Tufts large and dense, one to three inches high. *Filaments* much finer than human hair, excessively flaccid, soft and sub-gelatinous, collapsing into a clot when removed from the water, much branched; the lower branches very irregular, sometimes close together and dividing at short intervals, sometimes more distantly branched; the upper branches repeatedly decompound-pinnate. *Plumules* sometimes long and virgate, narrow, simply pinnate or having the upper pinnules pinnellate or secundly ramulose; sometimes shorter and more ovate, and frequently with a flexuous rachis. *Articulations* destitute of veins, except near the base of the stem, many times longer than broad in the larger branches, four or five times or more in the smaller, cylindrical. *Tetraspores* on the inner face of the pinnulæ, few or several, secund, elliptical. *Favellæ* not seen on American specimens. *Colour*, a fine purplish rose-red. *Substance* very tender.

Var. *β* is smaller and still more slender than the common form, with longer internodes, and its typical state is readily known by the strong tendency to secund ramification; but this character is very variable.

In some of the numerous and beautifully preserved specimens with which Mr. Walters has favoured me, the ends of the upper branches are remarkably fastigiate and densely ramulose, and the external aspect is strikingly similar to that of *C. corymbosum*. Another specimen from the same gentlemen, dated July 6, 1851, has, to the naked eye, the aspect of *C. gracillimum*, the upper branches being distichously decompound-pinnate, with an ovate outline; all the ramuli remarkably patent and even recurved, the ultimate ones very generally secund. The substance appears rather more rigid than usual; and had I received this specimen alone it might possibly have passed for a distinct species; but after comparison with a large number of North American specimens of *C. byssoideum*, I fear its distinctive

characters are not sufficiently marked. Meantime I indicate it above as var. δ *Waltersii.*

8. Callithamnion *Dietziæ*, Hooper ; fronds capillary, pellucidly articulate nearly to the base, the lower part of the percurrent, distichously-pinnate stem veiny ; branches alternate, simple, set at each node with short, alternate, sub-simple or pinnato-dichotomous plumules, and often terminated by a dense fascicle of ramuli ; rachides zig-zag ; articulations of the stem six or eight times, of the rachides three or four times, of the ramuli eight or ten times as long as broad ; apices sub-attenuate, obtuse, or sub-acute ; tetraspores elliptical, tripartite, solitary on the uppermost ramuli.

Hab. Greenport, *Mrs. Dietz.* (v. s. in Herb. Hooper.)

Fronds tufted, two to three inches long, as thick as human hair. *Stem* either simple or divided near the base into several, long, simple, erect, main divisions, set throughout with alternate, patent, elongate, simple branches, which, in luxuriant specimens, probably bear a second set of similar smaller ones. Outline of the frond ovato-lanceolate. *Branches* alternate or sometimes secund, sub-distichous, articulate, each node bearing at alternate sides of the branch, a pinnato-dichotomous branchlet or plumule. *Plumules* with a ziz-zag rachis, either short with three or four pinnæ, or lengthening out, simply pinnate in the lower half, bi-pinnato-dichotomous above, each pinnule ending in a dense tuft of undeveloped ramuli. *Articulations* of the lower part of the stem three or four times as long as broad, veiny, with a narrow tube ; of the branches with thick, pellucid walls, six or eight times ; of the rachides of the plumules shorter, but of the ultimate pinnules six to eight or ten times as long as broad. *Colour*, a beautiful rosy-red. *Substance* soft, closely adhering to paper. *Tetraspores* tripartite, elliptical, solitary on the ultimate ramuli, formed from the suppressed arm of a furcellation.

Of this plant I have yet seen but few specimens ; too few to form a decided opinion on its specific validity. Notwithstanding its pinnate habit I am not without fears that a more extensive suite of specimens may show it to pass off into one of the forms of *C. corymbosum* or *C. versicolor.* The specific name is bestowed by Mr. Hooper in honour of its discoverer, *Mrs. Dietz* of New York.

Sect. 3. Corymbosa ; *Fronds setaceous or byssoid, alternately decompound ; the secondary branches and ramuli dichotomous, corymboso-fastigiate.*

9. Callithamnion *corymbosum*, Ag. ; fronds tufted or solitary, flabelliform, pellucidly articulate throughout ; stem and lower branches setaceous below, attenuated upwards to a byssoid fineness, decompound, much branched ; upper branches byssoid, excessively flaccid, pinnato-dichotomous or alternately or secundly decom-

pound ; the lesser and ultimate divisions dichotomously multifid and fastigiate ; articulations of the branches six or eight times as long as broad, of the ramuli shorter ; tetraspores solitary on the ramuli, tripartite. *J. Ag. Sp. Alg.* 2, *p.* 41. *Harv. Phyc. Brit. t.* 272. *Phlebothamnion corymbosum, Kütz. Sp. Alg. p.* 657. *Conferva corymbosa, E. Bot. t.* 2352. Var. *β secundatum ;* lesser branches very frequently secund, less compound than usual, and the ultimate ramuli very irregular, scarcely corymbose.

Hab. Frequently growing on *Zostera.* Halifax, *W. H. H.* Boston Bay in several places, *Dr. Durkee, Mrs. Mudge, Capt. Pike,* &c. New London, *Miss French, Mr. Congdon.* Providence, *Prof. J. W. Bailey.* *β*, Massachusetts Bay, *Mrs. Mudge.* Greenport, *Mr. Hooper.* (v. v.)

Fronds either densely tufted, as is often the case when growing on the leaves of *Zostera*, or solitary, as sometimes occurs in rockpools or on a sandy bottom. *Stems* as thick as hog's bristle at the base, soon divided, and then alternately decompound. The larger branches are setaceous below, attenuated upwards, and at length reduced, near the summit, to a cobwebby fineness ; they are very much branched, the primary divisions between alternately pinnate and dichotomous, the secondary and tertiary somewhat zig-zag and set with alternate or secund, dichotomo-multifid branchlets. These dichotomous branchlets are usually fastigiate or level-topped ; the ends, owing to the crowded ramuli, looking dark when displayed on paper, and resembling so many little corymbs ; whence the specific name. The articulations are visible to the base of the stem ; those in the lower part are short, sometimes a little veiny, thick-walled, with a slender tube ; those of the middle and upper portions are very long. The *tetraspores* are always solitary, scattered on the upper ramuli, being formed out of a suppressed arm of a furcellation. *Favellæ*, binate. *Substance*, somewhat gelatinous. *Colour*, a beautiful rosy red, rapidly given out in fresh water.

10. Callithamnion *seirospermum*, Griff. ; fronds solitary or somewhat tufted ; stem setaceous, veiny, gradually attenuated upwards, undivided, set with alternate, lateral, setaceo-capillary, veiny, undivided branches, which are clothed with lateral, spirally inserted, dichotomo-multifid, secondary branchlets ; articulations of the stem and branches opaque, of the lesser branches and ramuli pellucid, three to four times as long as broad ; the ultimate ramuli frequently converted into bead-like strings of seirospores. *Harv. Man. Ed.* 1, *p.* 113. *J. Ag. Sp. Alg.* 2, *p.* 42. *Phlebothamnion seirospermum, Kütz. Sp. Alg.* 2, *p.* 657. *Seirospora Griffithsiana, Harv. Phyc. Brit. t.* 21. *Cal. versicolor, var. seirospermum, Harv. in Hook. Joam, Bot.* 1, *p.* 302.

Hab. Salem, Massachusetts, *Mr. J. Hooper.* New Bedford, *Dr. Roche.* Nantucket, *Dr. Durkee.* Shores of Rhode Island, *Prof. J. W. Bailey.* (v. v.)

Stem, three to five inches high, as thick as hog's bristle below, capillary above,

undivided, running through the frond, set throughout with alternate, spirally-inserted, lateral, sub-horizontal branches directed to all sides, the lowest longest, the rest successively shorter; the whole frond pyramidal. Both the stem and primary branches are filled with veins, which render their articulations more or less obscure. *Branches* undivided, one to two inches long, attenuated upwards, and copiously furnished throughout with short, very flaccid, capillary or byssoid, dichotomo-multifid branchlets directed to every side; the ultimate divisions of these are almost cobwebby. I have not seen proper *tetraspores;* but their place is generally supplied by the conversion of the ultimate ramuli into strings of spores; affording a mark by which this species is most easily recognised. When first I described this fructification (in *Hook. Journ. l. c.*) I regarded it as an abnormal development, and perhaps correctly, though more recently (in the *Phycologia Britannica*) I adopted another opinion, and thereon founded the genus *Seirospora*. If the strings of *seirospores* be abnormal, however, they are, so far as I know, only found in this species, and are very constant, characterising it on the shores of England, Ireland, Scotland and Sweden, as well as on those of North America. I am indebted to Dr. Roche of New Bedford for most beautiful specimens, which are identical with the most luxuriant of my English ones.

Sect. 4. Cruciata: *Fronds setaceous or capillary, alternately decompound, articulate; each node bearing a pair of opposite, minute, simple or compound ramuli. Tetraspores cruciate.*

11. Callithamnion *plumula*, Lyngb.; stems alternately decompound or subdichotomous, articulated; each articulation bearing a pair of short, recurved, pectinate or bi-pectinate ramuli; tetraspores borne on the tips of shortened ramuli, cruciate. *J. Ag. Sp. Alg.* 2, *p.* 29. *Harv. Phyc. Brit. t.* 242. *Kütz. Sp. Alg.* 2, *p.* 647. *Conferva Plumula, Ellis.—Dillw. t.* 50. *Conf. Turneri, E. Bot. t.* 1637.

Hab. Longbranch, New Jersey, *Miss E. C. Morris.* (v. v.)

Of this beautiful species I have only seen a solitary, ill-dried and faded North American specimen. It is at once known from *C. Americanum*, which is sometimes mistaken for it by collectors, by the very patent or recurved ramuli, closely *pectinated* on their upper margin only, with secund pinnellæ.

12. Callithamnion *Americanum;* filaments elongate, capillary, many times alternately decompound, closely and densely or sub-distantly branched, plumose; ramuli in pairs from every node, opposite, patent, very slender, pinnellate or bi-pinnellate, the pinnules opposite or secund; lower articulations of the stem eight or ten times, upper four or five times as long as broad; articulations of the ramuli four to six times as long as broad; tetraspores elliptical, cruciate, sessile; favellæ in pairs on the upper branches. (Tab. XXXVI. A.)

Hab. Prince Edward's Island, *Dr. Jeans.* Halifax, *W. H. H.* Boston, *Mrs. Asa Gray.* Lynn, *Mrs. Mudge.* Portsmouth, *Dr. Durkee.* New Bedford, *Dr. Roche.* New York Bay, *Mr. Hooper.* (v. v.)

Filaments three to four inches long, capillary, densely tufted, much and finely branched, alternately decompound ; the lower divisions sub-distant, the upper close together, all rather patent, the secondary branches elongate, the tertiary and succeeding short. Every part of the filament is pellucidly articulate, without veins. Each articulation bears a pair of very slender, byssoid, opposite ramuli one to two lines long, very patent and oppositely pinnate or bi-pinnate ; the pinnules sometimes abortive or abbreviated, when the branching becomes irregularly alternate or sub-secund. *Apices* attenuate, acute. *Articulations* in the lower part of the stem and branches many times longer than broad, in the lesser branches five or six times, in the ramuli frequently six or eight times, but sometimes only four or five times as long as broad. *Tetraspores* sessile, near the base of the pinnæ on the ramuli, elliptical, cruciate. *Favellæ* near the ends of the lesser branches, large, berry-like, in pairs or threes. *Colour*, a brilliant, rosy red. *Substance*, very flaccid and delicate. It closely adheres to paper in drying.

A very beautiful species, not uncommon on the East Coast of North America from Nova Scotia to New York.

Plate XXXVI. A. *Fig.* 1. Callithamnion *Americanum ;* the *natural* size. *Fig.* 2, part of a larger branch, with lateral branches, aud pinnate, opposite ramuli ; *fig.* 3, part of a branch with *favellæ ; fig.* 4, the same with *tetraspores ; fig.* 5, a fertile, lower pinna from the preceding ; the latter figures more or less highly *magnified.*

13. Callithamnion *Pylaisæi*, Mont. ; filaments elongate, ultra-capillary, alternately decompound ; branches distant, erecto-patent ; ramuli in pairs, opposite at every node, pinnate or bi-pinnate, the pinnæ opposite or rarely secund ; lower articulations of the stem many times longer than broad, upper two to four times ; articulations of the ramuli once or twice as long as broad ; tetraspores elliptical, sessile on the ramuli, cruciate. *Mont. Ann. des Sc. Nat. 2nd Ser. vol.* viii. *p.* 351. *Wrangelia Pylaisæi, J. Ag. Sp. Alg.* 2, *p.* 705. *Callith. intermedium, Harv. MSS.* (Tab. XXXVI. B.)

Hab. Newfoundland, *De la Pylaie !* South Boston, *Dr. Durkee !* (v. s. in Herb. T. C. D.)

Filaments three to four inches, rather thicker than human hair, alternately four or five times decompound, the lower branches distant, the upper gradually nearer ; every part pellucidly articulate. From a short distance below each node of the stem and branches springs a pair of opposite ramuli about half a line in length, some of them simply pinnate, some few secundly pectinate, but the greater number bi-pinnate, ovate in outline, all the pinnules tapering to an acute point. Lower

articulations of the stem six to eight or ten times as long as broad ; upper much shorter, and those near the ends of the branches but twice or thrice as long as broad. The articulations of the ramuli are very short. *Tetraspores* numerous on the pinnæ of the ramuli, sessile, cruciate. *Favellæ* unknown. *Colour* a fine crimson.

This plant has the external aspect of *Cal. floccosum*, but is more robust, and is readily distinguished by its compound ramuli. It is more closely related to *C. Americanum*, but the ramuli are shorter and more densely branched, with much shorter internodes. The differences between these species may more readily be understood, by comparing the figures we have given than by a detailed description.

Until the favellæ of this plant be discovered, some doubt may rest upon its generic position, yet I cannot but think it more nearly related to *C. Americanum* and *C. floccosum*, between which it is nearly intermediate in character, than to *Wrangelia multifida*, with which Professor Agardh associates it.

Plate XXXVI. B. *Fig.* 1. Callithamnion *Pylaisœi ;* the *natural* size. *Fig.* 2, portion of a branching stem, *magnified. Fig.* 3, internode of a branch, with opposite, bi-pinnate, fertile ramuli ; *fig.* 4, pinnule from the same, with *tetraspores ;* more highly *magnified.*

14. Callithamnion *floccosum*, Ag. ; frond capillary, very flaccid, remotely much branched ; branches alternate, erecto-patent, articulated ; every node emitting a pair of opposite, simple, subulate, erecto-patent, minute, ramuli ; tetraspores elliptical, pedicellate on the ramuli near the base. *J. Ag. Sp. Alg.* 2, *p.* 27. *Harv. Phyc. Brit. t.* 81. *Kütz. Sp. Alg. p.* 646.

Hab. South Boston, very rare, *Dr. Durkee.* (v. s. in Herb. T. C. D.)

Filaments capillary, four to six inches long, alternately or sub-dichotomously branched, the lower divisions distant, from half an inch to an inch or more apart, the upper gradually closer together. Secondary and lateral branches repeatedly divided alternately ; the general outline lanceolate or somewhat rhomboid. *Ramuli* opposite, a pair springing from every internode of the frond at a short distance below the node, distichous, a quarter to half a line long, erecto-patent, quite simple spine-like, subulate, tapering to an acute point. *Articulations* in the lower part of the stem six or eight times as long as broad, without veins ; in the upper branches gradually shorter, near the apices twice or thrice as long as broad, the terminal ones shorter than their breadth. *Articulations* of the ramuli once and half or twice as long as broad.

I have as yet seen but a solitary American specimen, and it is without fruit.

15. Calithamnion *cruciatum*, Ag. ; filaments short, in globular tufts, subfastigiate, alternately decompound ; branches erect ; ramuli at every node in pairs

or fours, densely crowded at the tips of the branches, opposite, very erect, pinnate; pinnæ opposite, very erect, cylindrical, obtuse, scarcely tapering; articulations of the stem and branches variable, of the ramuli three or four times as long as broad; tetraspores terminating the lower, abbreviated pinnæ of the ramuli, cruciate. *J. Ag. Sp. Alg.* 2, *p.* 27. *Harv. Phyc. Brit. t.* 164. *Kütz. Sp. Ag. p.* 549. *β tenue;* slender, with more distant, less compound and shorter ramuli.

Hab. New York Bay, at Red Hook, *Messrs. Walters* and *Hooper*. (v. v.)

Tufts dense, globose and somewhat level-topped, an inch to an inch and half high. *Filaments* capillary, alternately divided, but not much branched, the branches erecto-patent, the upper ones shorter and closer together, the lower distant. *Ramuli* at every node two opposite or four in a whorl, half a line to a line in length, densely crowded at the ends of the branches, rarely more than simply pinnated. *Pinnæ* very erect, opposite or, by suppression of one, alternate or secund, the inner pinnæ being most commonly abortive, cylindrical, or slightly tapering to an obtuse point. *Internodes* of the stem and branches four to six times as long as broad, of the upper branches twice or thrice, of the ramuli about thrice as long as broad. *Fruit* rare and not yet observed on American specimens. *Colour*, a brownish-red, inclining sometimes to purple. *Substance* soft, but not very flaccid. It adheres closely to paper in drying.

As yet I am only aware of the single American station for this species above given. Mr. Walters's specimens of both varieties are very similar to those found in the South of England.

Sect. 5. Repentia. *Fronds (of small size) rising from prostrate creeping matted threads. Favellæ involucrate.*

16. Callithamnion *Turneri*, Ag.; filaments (densely tufted) rising from prostrate, creeping fibres, simple or repeatedly branched, once or twice pinnated with opposite or alternate spreading, simple ramuli; articulations very variable in length, 5—10 times as long as broad; tetraspores clustered, sub-racemose or corymbose, on abbreviated ramuli; favellæ involucrate. *J. Ag. Sp. Alg.* 2, *p.* 23. *Harv. Phyc. Brit. t.* 179. *Kütz. Sp. Alg. p.* 649. *Conferva Turneri, Dillw. t.* 100, *E. Bot. t.* 2339. *β variabile;* branches and ramuli alternate or secund. *Callithamnion variabile, Ag. Cal. roseolum?* *J. Ag. Sp. Alg.* 2, *p.* 21. *Conferva repens, Dillw.* 18, *E. Bot. t.* 1608.

Hab. Parasitical on various Algæ. Rhode Island, on *Cladostephus, Prof. J. W. Bailey.* *β* Boston, *Dr. Durkee.* Key West, *W. H. H.* (v. v.)

Filaments rising from decumbent, creeping, matted fibres, densely tufted, half an inch to an inch in height, capillary, flaccid, sub-simple, or once or twice oppositely branched; stem, branches and ramuli all nearly of the same diameter, and all pellu-

cidly articulate, with thick hyaline cell-walls. *Articulations* very variable in length in different specimens and in different parts of the same specimen, four to twelve times as long as broad, the upper ones shortest. *Branches* and ramuli patent, scarcely attenuate, obtuse, in some specimens regularly opposite, in others frequently alternate or secund. *Tetraspores* almost always pedicellate (terminating depauperated ramuli), solitary or clustered, spherical, tripartite, with broad perispores. *Colour*, a rosy or brownish red. *Substance* soft. It adheres to paper.

Our var. β closely agrees with specimens of *Cal. roseolum*, Ag. communicated to me by Prof. Areschoug; but I think it also passes insensibly into the *Cal. variabile*, Ag. which Prof. J. Agardh now agrees with me in uniting to *C. Turneri*. In Prof. Bailey's specimens the ramuli are almost always opposite; in Dr. Durkee's as constantly alternate or secund; each agrees with a corresponding British form of this variable species.

Sect. 6. Pusilla: *Root a small callus. Fronds, minute, tufted, irregularly decompound, erect, growing on rocks, or parasitical.*

17. Callithamnion *Rothii*, Lyngb., tufts widely spreading, dense, velvetty; filaments very slender, short, erect, dichotomous or irregularly branched; branches long, straight, very erect or appressed; articulations about twice as long as broad; tetraspores clustered, borne on short, sub-terminal, corymbose ramuli. *J. Ag. Sp. Alg.* 2, *p.* 17. *Kütz. Sp. Alg. p.* 640 *Harv. Phyc. Brit. t.* 120. *B. Conferva Rothii, Dillw. Conf. t.* 73, *E. Bot. t.* 1702. *Byssus purpurea, E. Bot. t.* 192. *Dillw. Conf. t.* 43.

Hab. On submarine rocks near high water-mark. Halifax, *W. H. H.* Penobscot Bay, *Mr. Hooper.* Rhode Island, *Prof. Bailey.* (v. v.)

Filaments about a quarter inch in height, spreading in a continuous, velvetty pile, resembling crimson *plush*, over rocks and stones in patches from a few inches to many feet in extent. The plant is more or less luxuriant as it grows in deep or shallow water. The depauperated state called *Byssus purpurea*, E. Bot. grows at the extreme limit of the tide, in places where it is merely wet by the spray at high water.

The American specimens are not in fruit, but in other respects are the same as British ones.

18. Callithamnion *luxurians*, J. Ag.; filaments minute (2—3 lines high), excessively branched from the base, sub-dichotomo-multifid or secundly decompound; branches rather patent, very long, attenuated, with secund, whip-like, secondary branches and few ramuli; articulations four times as long as broad; tetraspores elliptical, pedicellate, scattered. *J. Ag. Sp. Alg.* 2, *p.* 14. *Kütz. Sp. Alg. p.* 639.

Hab. On *Zostera* at Newhaven, Connecticut, *Mr. Hooper*. (v. s. in Herb. Hooper).

Filaments forming a dense, deep-purple fringe, two or three lines in length, to the leaves of *Zostera*, excessively branched in a manner between alternate and dichotomous, the lesser divisions very generally secund. *Branches* flexuous, flabelliform.

The American specimens seen are faded. In other respects they agree with an authentic specimen received from Prof. J. Agardh; but I must add that this species appears to me to border too closely on the following, which is of earlier date.

19. Callithamnion *virgatulum*, Harv.; filaments minute (2—3 lines high), flabellately much branched from the base; branches alternately decompound, fastigiate; secondary ones few, erect, straight, rod-like, frequently secund; ramuli short, secund, often rising from every node; articulations about three times as long as broad; tetraspores elliptical, pedicellate, scattered on the branches. *Harv. in Hook. Br. Fl.* 2, *p.* 349. *Harv. Phyc. Brit. t.* 313.

Hab. Parasitical on *Dasya elegans*, at Hellgate, New York, *Mr. Walters*. (v. v.)

Fronds forming a dense velvetty pile, nearly of the same colour as the byssoid ramelli of the *Dasya*, and therefore likely to be overlooked. *Filaments* alternately or secundly decompound, all the angles acute and branches and their divisions straight and erect. *Ramuli* bud-like, secund, along the branches.

20. Callithamnion *Daviesii*, Ag.; filaments minute (2—3 lines high), tufted, much branched; branches curved, scattered, patent; ramuli elongate, fascicled or crowded toward the axil of the secondary branches; tetraspores pedicellate, on sub-axillary ramuli. *J. Ag. Sp. Alg.* 2, *p.* 11. *Harv. Phyc. Brit. t.* 314. *Kütz. Sp. Alg. p.* 638. *Conferva Daviesii*, *E. Bot. t.* 2329.

Hab. Parasitical on *Ceramium rubrum*. Boston Bay, *Miss E. Brewer*, *Dr. Durkee*. (v. v.)

Filaments about a line in height, generally forming a fleecy down on the *Ceramium*, more or less branched; sometimes sub-simple. *Colour*, a pinky-red.

APPENDIX.

GENERA INCERTÆ SEDIS.

[The following genera cannot be satisfactorily referred to their proper places in the system until their fruit shall have been discovered. *Wurdemannia* may perhaps belong to *Gelidiaceæ;* and *Pikea*, either to *Sphærococcoideæ* or to *Ceramiaceæ*.]

WURDEMANNIA. (*Nov. Gen.*)

Frond filiform, terete, irregularly branched, composed of three strata; the medullary of numerous, slender, cylindrical, seriated cells, disposed in sub-parallel, closely packed, longitudinal filaments; the intermediate of oblong, longitudinal cells gradually shorter towards the periphery, which consists of minute, vertical cellules, in a nearly single row. *Conceptacles* (unknown.) *Tetraspores* oblong, zonate, immersed in the peripheric cells of the swollen apices of the branches.

The little plant on which I venture to found the present genus has puzzled me a good deal. In its aspect it resembles *Caulacanthus*, but has a structure more nearly agreeing with that of *Gelidium* than of any other genus with which I have compared it. From *Gelidium*, however, it differs essentially in the zonate tetraspores. I had at one time thought of placing it, provisionally, in *Dicranema*, but after having consulted with my friend Prof. Agardh, who is equally unable with myself to point out its true affinities, I have determined to propose it as the type of a new genus, though its claims cannot be fully substantiated until the conceptacles shall be discovered. Meanwhile I inscribe it with the name of the late Dr. Wurdeman, a most meritorious naturalist, who first explored the marine botany of the Florida Keys, and from whom (through Prof. Lewis R. Gibbes) I received specimens of this plant, among many others.

Owing to the tenuity of the frond, it is difficult to obtain a longitudinal section. The structure above described has been ascertained by viewing small portions which had been treated with muriatic acid, and then strongly pressed between pieces of glass.

1. Wurdemannia *setacea ;* frond capillary, densely tufted, slightly branched, subdichotomous ; branches simple, naked, divaricating, the apices obtuse ; tetraspores zonate, lodged in the incrassated, club-shaped apices, or in club-shaped, apical, clustered ramuli.

Hab. Key West, abundant, *Dr. Wurdeman*, *W. H. H.* (53.) (v. v).

Fronds densely tufted, covering other Algæ, corals and Gorgoniæ with a shaggy coat, 2—3 inches high, as thick as horse-hair, rigid, matted together, not much branched. *Branches* irregularly dichotomous or secund, widely spreading and divaricate, equal in diameter throughout, their lesser divisions few, and similar in every respect. *Ramuli* very few, a line long, and mostly towards the ends of the branches. *Tetraspores* zonate, crowded in the apical, club-shaped, somewhat flattened and frequently fasciculate ramuli. *Colour*, a dark red. *Substance*, rather rigid. It scarcely adheres to paper in drying.

PIKEA. (*Nov. Gen.*)

Frond plano-compressed, linear, cartilaginous, internally costate, distichously decompound, composed of three strata : the *axis* being a single, articulated, percurrent filament ; the *intermediate stratum* consisting of slender, longitudinal, densely packed, anastomosing filaments ; the *cortical* very narrow, formed of minute cells. *Fructification* unknown.

In the absence of all knowledge of the fructification of this curious plant, it is impossible to speak with certainty of its affinities. Notwithstanding its inarticulate frond, I am disposed to refer it to *Ceramiaceæ*, near *Carpoblepharis ;* but this opinion is grounded as much on external habit as on the internal structure. Mere outward form, however, is a most fallacious guide to natural affinities ; and there are certain *Sphærococcoideæ* and *Cryptonemiaceæ* (especially *Prionitis*), to which, outwardly, our plant has considerable likeness. I am not acquainted with any Alga exactly agreeing in structure with it, and therefore propose it as the type of a new genus, which I inscribe to Capt. Nicholas Pike of Brooklyn, from whom I received the specimens, and whose many contributions of materials to the present volume are recorded under the species received from him.

1. Pikea *Californica ;* frond linear, more or less strongly compressed, flabelliform, distichous, sub-fastigiate ; branches irregularly disposed, repeatedly com-

pound, irregularly pinnate or secundly ramulose, the divisions erecto-patent, sometimes opposite, frequently secund, the upper ones plano-compressed; ultimate ramuli filiform or subulate, acute, not tapering at base, very erect, unequal, long and short intermingled.

Hab. Golden Gate, *Capt. Pike.* (50 in part, 78.) (v. s. in Herb. T. C. D.)

Frond 3 or 4 inches high, and as much in the expansion of the branches, stipitate, distichously branched in a palmato-flabelliform manner for a short distance above the base. *Branches* half a line to a line in breadth, compressed, sometimes nearly flat, sometimes approaching terete, very irregular in position, spreading, sub-simple and rather naked in the lower part, closely branched and repeatedly divided above. Lesser branches opposite, alternate or secund, small and large branches irregularly consecutive, somewhat pinnate, once or twice compounded. *Ramuli* very frequently secund, of very unequal lengths, filiform or setaceous, acute, very erect. *Colour*, a brown-red. *Substance*, cartilaginous and firm. *Fruit* unknown. A cross section of a small branch is a narrow ellipse, somewhat attenuated at the ends of the longer axis; there is a large central or axial tube, and two or more lesser tubes in the line of the longer axis; there is a narrow rim of minute, peripheric cells, and the whole of the interior space is filled with minute, endochromatic cells, being the cross cutting of longitudinal filaments. A longitudinal section shows a central long-jointed filament; a thin periphery of two other rows of minute coloured cells; and the intervening space formed of a very dense plexus of longitudinal filaments passing off towards the periphery into an imperfectly defined stratum of small, angular coloured cells. The central tube easily escapes observation in a longitudinal slice, unless the cutting be exactly through the middle of the frond.

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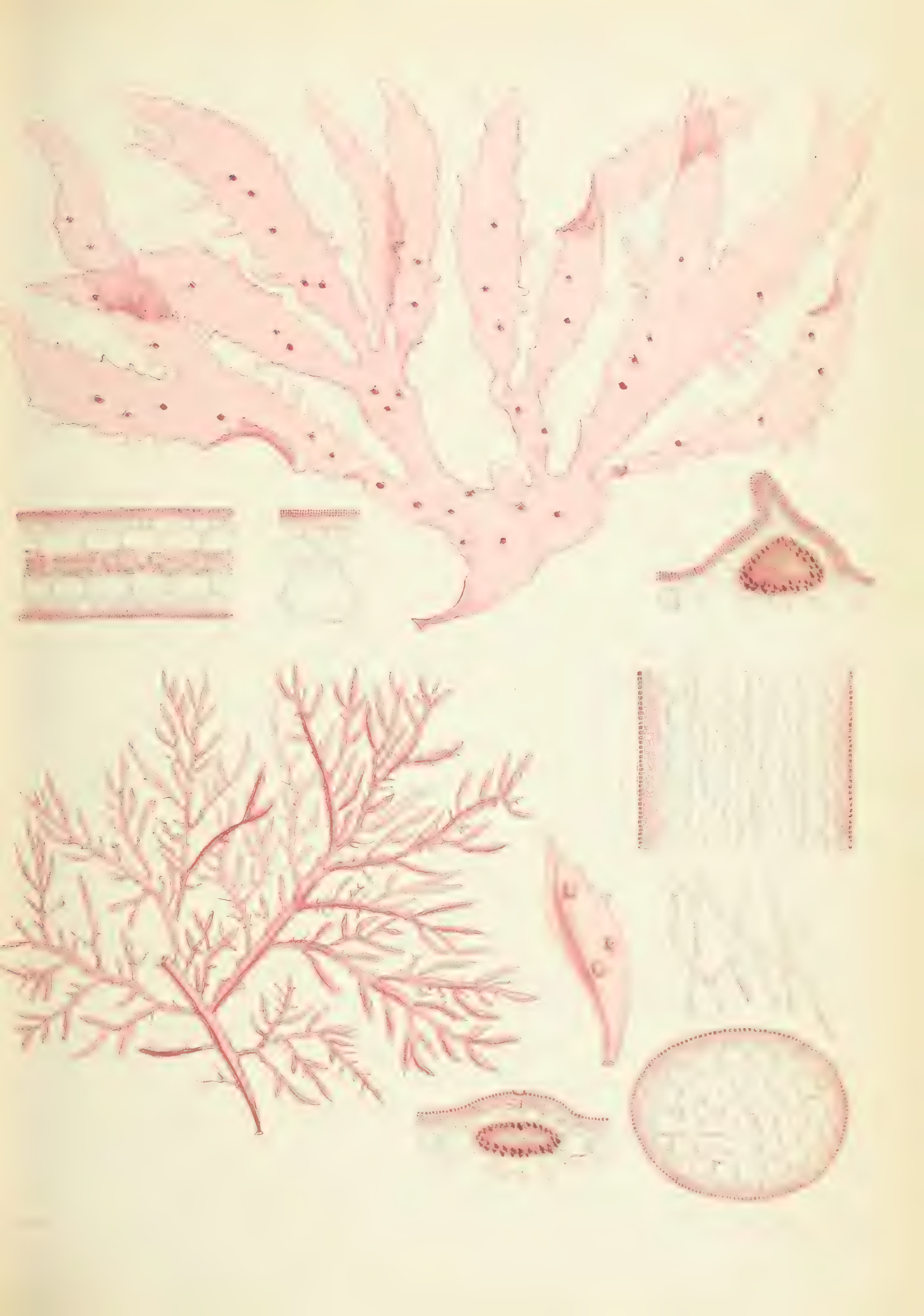
PUBLISHED BY THE SMITHSONIAN INSTITUTION,
WASHINGTON CITY,
MARCH, 1853.

Ford & West Imp. London



PLANTÆ TEXANO-NEO-MEXICANÆ.

PART II.

COMMISSION

TO WHICH THIS PAPER HAS BEEN REFERRED.

PROF. JOHN TORREY.

JOHN CAREY.

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CAMBRIDGE:
METCALF AND COMPANY,
PRINTERS TO THE UNIVERSITY.

PLANTÆ WRIGHTIANÆ

TEXANO-NEO-MEXICANÆ.

Part II.

The object of this memoir is to give a scientific account of the botanical collections made by Mr. Charles Wright, in New Mexico, or on the route thither from Eastern Texas, during the summer and autumn of 1851, and the spring and early part of the summer of the present year, 1852. In the former memoir, the publication of Mr. Wright's large collection made in 1849 was carried as far as to the end of the Order Compositæ. On the present occasion I propose to give a similar account of these more recent collections, up to the same point, and hereafter, as soon as other engagements will permit, to combine the account of the remaining portions of these several collections, along with those of Mr. Fendler and Mr. Lindheimer (the publication of which has likewise been arrested at the same point), into one general memoir.

Mr. Wright's collection in the year 1851 was made under the auspices of Colonel Graham, of the Topographical Engineers, while attached to the scientific corps of the U. S. Boundary Commission, then under Colonel Graham's charge. It is intended more particularly to illustrate the new genera and species it comprises in an appendix to Colonel Graham's Report, called for by the United States Senate: and a phytographical account of the regions traversed, and of the stations which particular plants occupy or affect, drawn up by Mr. Wright, at my request, will give the general features of the vegetation of the whole region. For the present I need only state, generally, where the collections were made. The first portion was gathered during the journey from San Antonio, Texas, to El Paso, in May and June, 1851, and therefore on ground that Mr. Wright had more leisurely traversed, two years previously, at a later season. This was forwarded to me in time for the incorporation of a part of its novelties in my former memoir (q. v. p. 17). The later portion was made from July to November, during a journey from El Paso to the copper mines of Santa Rita del Cobre, in the southwestern part of New Mexico, and thence into

the northern part of the Mexican state of Sonora, as far as to Santa Cruz, returning to the copper mines by way of Guadalupe Pass, and thence back to El Paso. This collection is one of exceeding interest; and, I think, comprises a larger proportion of new species than any other that has fallen into my hands.

In the spring of 1852, while performing his official duties in the Boundary Commission, under the orders of Major Emory, the successor of Colonel Graham, Mr. Wright made an interesting vernal collection, in the vicinity of El Paso and the rancho of Frontera, and down the Rio Grande for sixty or seventy miles; also up the valley as far as Camp Fillmore, and thence into the Organ Mountains which bound the valley on the east. A hasty excursion was also made to Lake Santa Maria and Lake Gusman in Chihuahua, the latter seventy or eighty miles southwest of El Paso. These vernal collections afford many novelties, no botanist having previously explored this region at that season of the year. The remainder of the collection for this year was gathered during a rapid journey, in June and July, from New Mexico back to Eastern Texas, by the route which Mr. Wright had already twice traversed. Still, it comprises a few plants not seen before, as well as specimens in a different state or better condition.

The numbers annexed, after the habitat, are those affixed to the distributed specimens; and, to avoid confusion, they follow from the end of Mr Wright's distributed collection of 1849. Specimens not thus numbered are ticketed with their names.

Harvard University, Cambridge, October, 1852.

RANUNCULACEÆ.

Clematis Pitcheri, *Torr. & Gray, Fl.* 1. *p.* 10; a form with the tips of the sepals prolonged. Valley of the Limpia; June; in flower. (830.)

C. reticulata, *Walt.*, var.? foliis tenuioribus, junioribus membranaceis. — Bottom of the San Pedro; May. (831.) — No. 384 of Lindheimer's coll. of 1850, New Braunfels, is the same plant, and I think a form of C. reticulata, which is abundant in Texas. Perhaps it may prove to be a new species, but I see no character besides its thinner leaves to distinguish it.

C. Viorna, var. coccinea. C. coccinea, *Engelm. Mss.* This was collected formerly by Mr. Wright about Austin, and towards the Rio Grande. It is No. 383 of Lindheimer's collection of 1850, from rocky and shady banks, New Braunfels, named by Engelmann C. coccinea, n. sp. The leaves are more glaucous, and the thick sepals of a "pure carmine-red, very rarely purplish." But in the ordinary C. Viorna they are some shade of red-purple.

C. ligusticifolia, *Nutt.; Gray, Pl. Fendl. p.* 3. Hills along the Coppermine Creek, New Mexico; Aug., in flower. (832.)

Thalictrum Fendleri (*Engelm. in Pl. Fendl. p.* 5): dioicum, glabrum; foliis decompositis petiolatis summisve sessilibus; petiolulis patentissimis; foliolis rotundatis sæpius cordatis trilobis parvulis; sepalis late ovalibus obtusissimis; filamentis apice vix incrassatis; antheris mucronatis; carpellis oblique ovatis complanatis acute marginatis lateribus 4–5-nervato-costatis sessilibus vel in stipitem brevem contractis stigmate styliformi gracili incurvo subulatis. — Hill-sides of Coppermine Creek, Aug.; male specimens in flower; the female with immature fruit. (833.) — This species is more nearly related to T. dioicum than to T. Cornuti, having nearly the foliage and the broad sepals of the former. It likewise varies, as does T. dioicum, with sessile and short-stipitate carpels. In Fendler's plant they are sessile; but in those of Wright they are raised on a manifest though short stipe.

Thalictrum Wrightii (sp. nov.): dioicum, glabrum; foliis omnibus petiolatis 2–4-ternatisectis; foliolis cuneato-obovatis oblongisve trilobis, adultis reticulatis; floribus paniculatis sparsis; sepalis subulato-lanceolatis ovaria subæquantibus; carpellis ovatis subcompressis 8-costatis sessilibus stigmate styliformi paullo longioribus. — Mountain ravine at Santa Cruz, Sonora, Mexico; Sept. (834.) — Stems 12 to 18 inches high, slender. Radical and lowest cauline leaves 3–4-ternately compound; the upper biternate, and in the loose paniculate inflorescence 3-foliolate or even simple. Leaflets 4 to 6 lines long, in form much like those of T. Cornuti, glaucescent beneath, at length prominently reticulated. Primary petioles 6 to 12 lines long. Panicle slender, simple or sparingly compound. Pedicels filiform, 6 to 12 lines long. Staminate flowers not seen. Sepals in the pistillate flowers a line or less in length, greenish, lanceolate or nearly subulate, caducous. Ovaries 8 to 12, flattish, scarcely nerved, rather shorter than the subulate stigma. Mature carpels a line and a half or two lines long, roundish-ovate, compressed, or turgid when fully

ripe, pretty strongly 4-ribbed, two of the ribs marginal and two lateral, and with four usually less conspicuous ribs alternate with these.*

Anemone Caroliniana, *Walt.; Torr. & Gray, Fl.* 1. *p.* 12. Mountain ravine near El Paso, April, in fruit. (1304.)

Myosurus minimus, *Linn.* Low bottoms of the Rio Grande, at San Elizario; March. (1305.) Also gathered on the Rio Santa Maria, Chihuahua, by Dr. Bigelow.

Ranunculus divaricatus, *Schrank, Bairsche Fl.* 2. *p.* 104. R. circinnatus, *Sibth. Fl. Ox. p.* 175; *Coss. & Germ. Atlas Fl. Par. t.* 1. *f.* 9. R. aquatilis, *Auct. Amer.* Bed of the Limpia (June), and of the Mimbres, New Mexico, Aug. (835.) — This is the only species of the section Batrachium that I have seen in the United States.

R. Cymbalaria, *Pursh.; Torr. & Gray, Fl.* 1. *p.* 17. Sandy bottom of the Rio Grande, near El Paso; April, July. (836.) — This is quite like the plant of the coast of the Northern United States. I doubt if Hartweg's No. 1, and Fendler's No. 7, referred to R. tridentatus, *H. B. K.*, are distinct.

R. affinis, *R. Br.; Hook. Fl. Bor.-Am.* 1. *p.* 12. *t.* 6 (fig. sinistr.). Hills along the Coppermine Creek, New Mexico; Aug. (837.) — This is a slender form of the species, quite different from Fendler's No. 8, with the radical leaves deeply cleft or parted, and the cauline mostly 3-parted, into very narrow linear divisions. In these specimens the head of fruit is nearly as short as in R. auricomus; but the carpels are rounder and less margined.

R. repens, *Linn.* var. macranthus, *Gray, Pl. Lindh.* 2. *p.* 141, & *Pl. Wright. p.* 7. R. macranthus, *Scheele.* Margins of the Limpia; June. (838.) — These are taller and stouter plants than those of Lindheimer, on which Scheele founded his R. macranthus, and are particularly remarkable for the great number of densely packed carpels, the edges of which are thicker and the styles longer than in Scheele's plant. Had R. macranthus been founded on the present form, I should hardly have ventured to suppress it; but the fruit of the Texan plant is just that of R. repens, var. Marilandicus; some genuine specimens of which Mr. Wright collected on the Mimbres, New Mexico. (839.)

Delphinium azureum, *Michx.* Along the Limpia, near its head; June. (840). — D. vimineum, *Don*, is only a coarser-leaved form of the present species, and D. virescens, *Nutt.*, is another.

D. simplex, *Dougl. in Hook. Fl. Bor.-Am.* 1. *p.* 25; *Benth. Pl. Hartw. p.* 295. Stony hills near the copper mines, Santa Rita del Cobre, New Mexico. (841.) — A pretty large form of the species. — D. variegatum, *Torr. & Gray* (D. grandiflorum, *Hook. & Arn. Bot. Beech.*), is D. decorum, *Benth. Pl. Hartw.* No. 1631, and doubtless also of Fischer and Meyer.

* Thalictrum debile, *Buckley in Sill. Jour.* 45. *p.* 175, or a plant which I can distinguish from it only by the stronger ribs to the fruit, was formerly sparingly gathered in Texas by Mr. Wright, and also at San Felipe by Drummond (Coll. III. No. 3, bis, in herb. Hook.)

T. clavatum, *Hook. Fl. Bor.-Am.* 1. *p.* 2, non *DC.* (T. Richardsonii, *Gray, in Sill. Jour.* 42. *p.* 17), is the same as T. sparsiflorum, *Turcz.; Ledeb. Fl. Ross.* 1. *p.* 5, as is shown by original specimens in the Hookerian herbarium.

D. SCOPULORUM (sp. nov.): puberulum vel glabrum; caule folioso simplici; petiolis basi dilatatis; foliis circumscriptione orbiculatis 3–5-partitis, divisionibus alte 2–3-fidis, segmentis multilobatis vel laciniatis; racemo stricto multifloro; floribus glabriusculis; calcare sepalis longiore; petalis inferioribus bifidis intus parce barbulatis, ungue basi calcarato. — Mountain ravine, near the Mimbres, New Mexico; Oct. (842.) — I believe this is the Delphinium exaltatum of Hooker's *Flora Bor.-Amer.*, so far as relates to the plant of Drummond, from the Rocky Mountains; but it is not the D. exaltatum of the United States. The latter is a tall plant, four or five feet high, with a mostly compound raceme, and much less dissected lobes to the leaves; the segments or lobes of the upper ones are either 2–3-cleft or entire and lanceolate, so as to render very appropriate the name of D. tridactylum, under which it is well described by Michaux (foliis tripartito-palmatis, laciniis lanceolatis parceve divisis). Our present plant is only one or two feet high, including the strict raceme of pretty large indigo-blue flowers; the principal and secondary divisions of the leaves are cuneiform in outline, much lobed or cleft; the lobes of the radical leaves oblong; of the cauline, linear and short, making the leaf appear laciniately multifid. The calyx is minutely pubescent externally, and with the spur from half to three quarters of an inch in length, considerably longer than the sepals. Carpels 3, erect, nearly glabrous. — D. Californicum, which Hooker (*Bot. Beechey, p.* 317) also refers to D. exaltatum, has less laciniated leaves than the present species, and much smaller, dull-colored (greenish-ochroleucous) flowers, which are hairy outside, and with the spur not longer than the sepals.

AQUILEGIA LEPTOCERA, *Nutt. in Jour. Acad. Philad.* 7. *p.* 9.; *Hook. Bot. Mag. t.* 4407; var. FLAVA; floribus saturate flavis. — Wet places in a ravine, Organ Mountains, northeast of El Paso; April. (1306.) Also gathered by Mr. Thurber in Sonora, and on the Organ Mountains by Dr. Parry. — This appears to be only a decidedly yellow-flowered variety of the plant gathered in the Rocky Mountains by Nuttall, Burke, &c., and figured by Hooker in *Bot. Mag. t.* 4407, and previously in *Bot. Beech. t.* 72, under the name of A. macrantha; — which name should be adopted in case the A. leptoceras of Fischer and Meyer should prove to be of earlier date and a good species. With Hooker, we pass by the earlier A. cærulea, *Torr.*; the flowers being ochroleucous according to Nuttall, or greenish-white, with slight tinges of yellow and purplish, in the plant raised by Hooker from seeds sent by Mr. Burke. The clear yellow blossoms of the present plant should perhaps distinguish it specifically; but I find no other points of difference. From the extraordinary size of the flowers and their handsome color, this would be the most showy known Aquilegia, and it would probably be hardy in the Northern United States.

MENISPERMACEÆ.

COCCULUS CAROLINUS, *DC.; Gray, Gen. Ill.* 1. *t.* 28, *& Pl. Wright. p.* 7. Pebbly banks of Howard's Creek, Western Texas; July. (1307.) — A variety with the leaves very downy underneath.

FUMARIACEÆ.

Corydalis aurea, *Willd.* var. siliquis breviusculis leviter curvatis adscendentibus. — Sandy hills along the Rio Grande, near El Paso; Feb., March. (1309.) — This is intermediate between the ordinary form of the species and No. 433 of Lindheimer's collection in 1850, named C. curvisiliqua, n. sp. by Engelmann. That has still longer pods (an inch and a half long), on shorter pedicels.

PAPAVERACEÆ.

Eschscholtzia Douglasii, *Hook. & Arn. Bot. Beech. p.* 320; *Torr. & Gray, Fl.* 1. *p.* 664; var. parvula. Among rocks, on mountains near El Paso, where it was first detected by *Dr. Bigelow;* April. (1310.) — Also on the Santa Maria, near Lake Gusman. — This is the first time that an Eschscholtzia has been found east of the Pacific border of Oregon and California. It appears to be only a rather depauperate form of the Oregon species. The petals are three fourths of an inch in length.

CRUCIFERÆ.

Nasturtium palustre, *DC.* Old bed of the Rio Grande, 50 miles below El Paso, June, and Cimicluque Spring, April. (843.) — These specimens have pods as long as those of the European plant. In most North American specimens they are much shorter. (Vide *Pl. Fendl. p.* 6.)

N. obtusum, *Nutt. in Torr. & Gray, Fl.*; *Gray, Pl. Fendl. p.* 6. With the preceding.

Turritis patula, *Graham; Gray, Pl. Fendl. p.* 7. Mountains near Coppermine Creek, New Mexico. Also, in fruit, near Lake Santa Maria, Chihuahua. (1313). — To this belongs the Streptanthus virgatus, *Nutt. in Torr. & Gray, Fl.* The ripe seeds occupy a single row; and the genus is not distinguishable from Arabis.

Streptanthus longifolius, *Benth. Pl. Hartw. p.* 10; *Gray, Pl. Fendl. p.* 6. Mountains and stony hills near the copper mines; Aug. (in flower). (844.) — The leaves are only from $1\frac{1}{2}$ to 2 or 3 inches in length; the radical and lower cauline ones spatulate.

S. linearifolius, *Gray, Pl. Fendl. p.* 7, *& Pl. Wright. p.* 7. Valley of the Limpia, and pebbly beds of streams, from the Mimbres to the copper mines; also at Lake Santa Maria, Chihuahua. — Root often thickened and ligneous, certainly perennial.

S. platycarpus (sp. nov.): glaberrimus, glaucescens; foliis caulinis cordato-oblongis amplexicaulibus sinu clauso integerrimis repandisve, infimis obovato-oblongis sæpe lyrato-pinnatifidis petiolatis; siliquis oblongo-linearibus planis erectis. — Valley of the Pecos, on stony hills; June. (844 bis.) — Root annual. Stem rather stout, branched from the base, 1 to 2 feet high. Radical leaves 6 or 8 inches long, thickish, lyrately pinnatifid; the lower cauline similar, or obovate and entire or nearly so; the upper cauline and rameal leaves from 3 to $1\frac{1}{2}$ inches long, usually quite entire, obtuse, or the upper acute, strongly cordate-clasping, with the rounded posterior lobes approximate or overlapping. Racemes loose, paniculate. Bracts none, or sometimes a minute one at the base of some of the pedicels, or with a foli-

aceous one subtending the lowest pedicel. Calyx violet-purple, open; the sepals 5 lines long, oblong-lanceolate, obtuse, not saccate at the base, nor carinate. Petals purple; the claw as long as the calyx; the ample and spreading lamina obovate-orbicular, 5 lines long. Anthers linear, elongated, sagittate at the base, the apex recurved. Siliques erect, straight or slightly falcate, 2 to 3 inches long, 2 or 3 lines wide, tipped with a very short style or a subsessile two-lobed stigma (the lobes alternate with the placentæ): valves flat. Seeds orbicular, broadly winged. — Allied to S. bracteatus, and especially to S. obtusifolius, *Hook.*, which is the same as S. maculatus, *Nutt.* (a prior name, though not a very good one); the leaves being either acute or obtuse, the uppermost more commonly acute. From both, the present species is at once distinguished by its broad and flat pods, which are fully $2\frac{1}{2}$ lines wide, even when less than two inches in length. Subjoined are the contrasted characters of the two allied species.*

S. CARINATUS (sp. nov. *Wright. in litt.*): glaberrimus, glaucus; foliis radicalibus caulinisque inferioribus sæpissime runcinato-pinnatifidis, superioribus integerrimis oblongis seu lanceolatis basi profunde cordata amplexicaulibus sinu clauso; calyce purpureo urceolato 5-angulato, sepalis carinatis basi saccatis; petalis linearibus crispatulis purpureo pictis paullo exsertis antheras vix superantibus; siliquis immaturis lato-linearibus erectis. — Stony hills, in a cañon, on the road to Texas, about 60 miles below El Paso; March. (1312.) — Root annual or biennial. Stems one or two feet high, simple or sparingly branched. Radical and lower leaves obovate or oblong, 2 or 3 inches long, narrowed into a short petiole, either toothed, lyrate, or runcinate-pinnatifid; the upper all strongly clasping by broad and rounded lobes. Raceme loosely flowered; pedicels ascending, 2 to 5 lines long, bractless, or the lowest occasionally with a foliaceous bract. Flowers half an inch long; the strongly saccate and carinately 5-angular calyx deep purple. Petals with the recurved limb scarcely dilated, obtuse, rose-color veined with purple. The forming pods are from one to two inches long, a line and a half broad, flattish, nearly straight. Stigma sessile, 2-lobed. — A striking new species of the section Euclisia.

DRYOPETALON, *Nov. Gen.*

Calyx basi inæqualis; sepalis oblongis, 2 majoribus basi subsaccatis. Petala obovato-spathulata, inciso-5 – 7-lobata, in unguem brevem attenuata. Filamenta subulata, edentula: antheræ oblongæ, sagittatæ. Stigma sessile, subglobosum, emarginatum. Siliqua filiformis, teres, haud stipitata, polysperma; septo enervi; valvis 3-nerviis nervo medio carinatis. Semina in loculis uniserialia, e funiculo libero

* STREPTANTHUS MACULATUS (*Nutt. in Jour. Acad. Philad.* 5. *p.* 134. *t.* 7): glaberrimus, glaucus; foliis caulinis cordato-oblongis amplexicaulibus sinu clauso (obtusis v. superioribus acutis), infimis obovatis; siliquis erectis anguste linearibus subtetragonis elongatis. — S. obtusifolius, *Hook. Bot. Mag.* *t.* 3317; *Torr. & Gray, Fl.* 1. *p.* 76; *Gray, Gen. Ill.* 1. *t.* 60. *f.* 4 – 7. Brassica Washitana, *Muhl. Cat.?* Stanleya Washitana, *DC.?*

STREPTANTHUS BRACTEATUS (*Gray, Gen. Ill.* 1. *t.* 60, *& Pl. Lindh.* 2. *p.* 143): glaberrimus, vix glaucus; foliis caulinis cordato-amplexicaulibus, infimis obovatis nunc denticulatis sæpe lyratis lobis dentatis; pedicellis bracteatis; siliquis angustissime linearibus prælongis subfalcatis patentissimis.

pendula, subcompressa, immarginata. Cotyledones ovales, planæ, radiculæ adscendenti subobliquæ accumbentes. — Herba annua vel biennis; foliis runcinato-pinnatifidis, radicalibus præsertim pube simplici molliter villosis subpetiolatis; racemis multifloris, pedicellis etiam fructiferis confertis; floribus albis.

Dryopetalon runcinatum. (Tab. XI.) — On mountains, near Lake Santa Maria, Chihuahua; April: mostly in fruit. (1314.) — Stem one to two feet high, branching, glabrous. Radical leaves 3 or 4 inches long, numerous, in a cluster, short-petioled, oblong or obovate, pubescent or villous, especially beneath, with soft and simple spreading hairs, deeply runcinate-pinnatifid; the lobes oval or oblong, coarsely toothed. Cauline leaves few, successively smaller and with narrower lobes, but otherwise similar, not auriculate or dilated at the base; the lower more or less petioled. Racemes one or two, or in fruit sometimes five or seven inches long. Pedicels closely approximate even at maturity, in flower ascending and 2 or 3 lines long; in fruit spreading and 5 or 6 lines long. Petals 3 lines in length, twice the length of the lax sepals, white, narrowly obovate; the limb incisely pinnatifid into 5 or usually 7 lobes, of which the upper are larger, and the lower very small, all directed forwards. Siliques about an inch and a half long, barely half a line in thickness, more or less arcuate-recurved, tipped with a small sessile stigma; the semicylindrical valves marked with a rather strong and prominent midnerve, and with a very slender lateral nerve (or at the base more than one) on each side, obscurely veiny. Seeds minute, numerous, about the width of the slender septum. Cotyledons plainly accumbent, but with the radicle slightly oblique. — With the foliage and pods of Sisymbrium, the crowded pedicels of Thelypodium, and the seeds of Arabis, but less compressed, this plant is one of the few Cruciferæ with lobed petals. In habit, as well as in the accumbent cotyledons, it is widely different from Perreymondia, *Barn.* and Schizopetalon, *Hook.* Moreover, if we neglect the petals, the terete pods will still exclude it from Arabis. Hence I have considered it the type of a new genus, and have named it from the outline of the petals, which is like that of a common oak-leaf.

Thelypodium Wrightii, *Gray, Pl. Wright. p.* 7; var. foliis caulinis superioribus laciniato-dentatis, inferioribus pinnatifidis, segmentis majoribus dentatis. — On mountains at the copper mines, New Mexico; Aug. (845.) — "Stems 2 – 5 feet high, much branched. Flowers light purple." — These specimens amply confirm the species, by their divaricate pedicels, short petals, and slender pods; they have besides deeply pinnatifid or laciniate leaves, only the uppermost and rameal ones being merely denticulate.

Sisymbrium canescens, *Nutt.; Gray, Gen. Ill.* 1. *t.* 64. Valley of Coppermine Creek; Aug. (846.) — A form with coarsely dissected leaves and rather large flowers. Also on the Rio Grande; in February.

S. auriculatum, *Gray, Pl. Wright. p.* 8. Hills between the Limpia and Leona Spring; June. (1315.)

S. diffusum, *Gray, Pl. Wright. p.* 8. Mountains at the copper mines, New Mexico, at the base of rocky ledges; Aug. (847.) — Fine flowering specimens, with the (white) petals rather longer than the calyx, but scarcely equalling the style.

Erysimum asperum, *DC.* Pebbly bed of the San Pedro, Limpio, and Mimbres.

Greggia camporum, *Gray, Pl. Wright. p.* 9. *t.* 1. Valley of the Rio Grande, below El Paso; June. Also in March, in flower. (1316.) — The large flowers are seldom white; but usually rose-color, changing with age to purple.

Draba micrantha, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 109; *Gray, Pl. Fendl. p.* 10. Stony hills, near El. Paso; March. (1317.) — The naked flowering stems are hairy to the top; and the petals are minute or wanting.

Vesicaria angustifolia, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 101; *Gray, Pl. Lindh.* 2. *p.* 145. On the Rio Frio and Leona, Western Texas; May; — a slender form. (834.) Also in valleys near the Rio Grande, about 60 miles below El Paso; March; — a form with larger flowers and pods, the latter somewhat stipitate. (1318.) Except in the more cinereous pubescence and the want of a considerable stipe to the silicle, I cannot distinguish this from V. gracilis, *Hook.*

V. recurvata, *Engelm.; Gray, l. c. p.* 147. Stony prairies from Chicon Creek to Piedra Pinta Creek, Western Texas; May. (849.) — To this belong the specimens of Berlandier referred by Hooker to his V. gracilis; but Drummond's plant (No. 13 of the third collection), from whose seeds was raised the plant figured under this name, is the true V. gracilis. — V. lasiocarpa, *Hook.* I have seen only in the Hookerian herbarium. The subjoined character was taken from the specimen.*

V. stenophylla, *Gray, Pl. Lindh.* 2. *p.* 149: var. *β.* procera; foliis omnibus latioribus lineari-spathulatis vel lanceolatis. — High rocky (limestone) prairies, Turkey Creek, Texas, and westward; May. (850.)

V. stenophylla, var. *γ.* siliculis ovatis! Gravelly banks of the Sabinal, Texas; May. (851.) — The silicles are from 3 to $4\frac{1}{2}$ lines long, ovate; the septum elliptical!

V. stenophylla, var. *δ.* humilis; foliis inferioribus spathulatis nunc parce dentatis; calyce pl. m. persistente! — Prairies at the head of the Limpio; also on the Pecos, &c.; June. (852.) — The condensed and broad-leaved specimens look very different from the ordinary state of V. stenophylla, into which, however, the living plants raised from their seeds evidently pass. The calyx is often persistent until the pod is nearly full grown.

V. stenophylla, var. *ε.* diffusa; foliis oblanceolatis et lineari-spathulatis pulchre argenteis. — V. arctica, *Gray, Pl. Fendl. p.* 9. — Stony hills on the Rio Grande, near El Paso; March. (1319.) — An early state of the species, between 850 and 852; and with an apparently annual root. To this (and not to the less silvery V. argyræa) belongs Fendler's No. 39, which is likewise an early state of this polymorphous species.

* Vesicaria lasiocarpa (*Hook. ined.* vide *Bot. Mag. sub t.* 3464): annua vel biennis; foliis tenuiter pubescentibus haud canescentibus oblongis pinnatifido-laciniatis; racemo laxo; floribus inferioribus sæpe axillaribus; pedicellis folium adæquantibus gracilibus (12 – 15 lin. longis), fructiferis apice recurvo-nutantibus; silicula immatura estipitata globosa stylo sublongiore (cum ovario) dense hirsuto-pilosa. — Between Bexar and Trinity River, May, 1828, *Berlandier* (in herb. Hook.). — Habit and foliage much that of V. grandiflora, but greener; the inflorescence nearly as in V. argyræa. Remarkable for its hirsute-hairy fruit.

V. PURPUREA (sp. nov.): multicaulis e radice crassa perenni; foliis canescentibus, radicalibus rosulatis obovatis oblongisve nunc sinuato-panduratis in petiolum attenuatis, caulinis paucis parvis sessilibus; racemis multifloris, fructiferis elongatis; petalis roseo-purpureis; siliculis ovoideo-globosis stylo gracili longioribus. — Stony hills near El Paso; March, April. (1320.) — Flowering stems numerous from a thickened root, scape-like and simple, erect, a span, or in fruit a foot, high, including the raceme. Radical leaves one to two inches long, half an inch or more in width, contracted into a petiole of nearly the same length, canescent and slightly scabrous with a very fine and close stellate pubescence, entire, or some of them sinuate and fiddle-shaped. Cauline leaves sparse, mostly bract-like, only from 2 to 4 lines in length, obovate, spatulate, or oblanceolate. Raceme strict, in fruit 3 to 6 inches long, with the spreading or at length recurved pedicels 3 to 6 lines long. Petals spatulate-obovate, 3 lines long, light purple (destitute of any tinge of yellow); the calyx sometimes tinged with purple. Filaments enlarged at the base. Ovary ovoid, glabrous, about the length of the style: ovules 5 or 6 in each cell. Silicle $1\frac{1}{2}$ to 2 lines in diameter, not stipitate; the valves hemispherical, membranaceous. Immature seeds orbicular, wingless; the funiculi free. Embryo not seen; but from the flatness of the seed the cotyledons are undoubtedly accumbent. — A genuine Vesicaria, of the section Vesicariana, with purple flowers!

DITHYREA WISLIZENI, *Engelm.; Gray, Pl. Wright. p.* 10. Valley of the Rio Grande, near El Paso, and above Doña Ana, common. (1321.) — D. Californica, *Harvey*, which I have seen in the herbarium of Trinity College, Dublin, has much smaller silicles than D. Wislizeni; they are also more deeply emarginate, the cells being nearly orbicular, and their thickened edge is tomentose.

THLASPI FENDLERI: foliis carnosulis subintegerrimis, radicalibus petiolatis ovalibus, caulinis sagittato-oblongis amplexicaulibus; racemo etiam fructifero brevi conferto; floribus majusculis; petalis calyce triplo longioribus; siliculis lato-obovatis subalatis basi acutis apice immaturis sinu aperto leviter obcordatis maturis truncato-subintegris, loculis 3 – 4-ovulatis; stylo filiformi fructu dimidio breviore. — T. cochleariforme, *Gray, Pl. Fendl. p.* 10, non *DC.*, nec *Hook.* — On the Organ Mountains, northeast of El Paso; May: mostly in fruit. (1322.) — Plant a span high, or lower; the raceme an inch, or, even in full fruit, not over 2 inches, in length; the pedicels closely approximate, spreading, in fruit 5 or 6 lines long. Petals (in Fendler's specimens) 4 lines long. Ovary obcordate by a broad and shallow sinus; the cells 3 – 4-ovulate. Ripe silicles 4 lines long, with sharp but slightly winged edges, obscurely emarginate or even truncate at the broad summit; the style a line and a half or two lines long. — The specimens of Fendler were mostly in flower only: mine with young fruit have the raceme more loose than in those gathered this spring by Mr. Wright; which, being in fruit, plainly show that I was wrong in referring the New Mexican plant to T. cochleariforme. The latter has the fructiferous raceme long and loose, and has likewise smaller flowers, narrower pods, with a deep and narrow apical sinus, and a short style. Our plant is more like T. præcox; which also has smaller flowers, and winged pods, with a very deep notch.

HYMENOLOBUS PUBENS, *Gray, Pl. Wright. p.* 9. On Rainwater Creek, between

the Limpio and the Rio Grande; June. (1323.) — These are younger specimens than those gathered in 1849, and show the lower leaves, which are much like the upper, only more sinuate-toothed and inclining to spatulate. The petals are white, and scarcely longer than the calyx.

Lepidium alyssoides, *Gray, Pl. Fendl. p.* 10, *& Pl. Wright. p.* 10. Valley of Live Oak Creek, Western Texas; May. Also on stony hills at the copper mines, New Mexico; Aug. (853.) Also on Rainwater Creek, June; a dwarf variety (1324); and on the Rio Grande below El Paso; a large form with the lower cauline leaves divided. (1325.)

L. montanum, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 116 *&* 669. Valley of Coppermine Creek, New Mexico, in sandy soil; Aug.; and west of the Chiricahui Mountains, Sonora; Sept. (854.) — This has orbicular-ovate (not elliptical) silicles, and is better described by Hooker and Arnott, in *Bot. Beechey, p.* 323, under the name of L. corymbosum, except that the older fruiting racemes are elongated. The petals are white and conspicuous; the stamens 6. Some specimens are nearly glabrous, others granulose and minutely hirsute-pubescent. I suspect that L. sordidum, *Gray, Pl. Wright. p.* 10, is only a late and depauperate state of the same species, producing diminished flowers.

L. Wrightii (sp. nov.): annuum, humile, hirsutulum; caulibus diffusis; ramis brevibus; foliis caulinis spathulatis dentatis vel incisis, imis et radicalibus sæpius pinnatifidis; floribus apetalis diandris; siliculis orbiculatis hispidulis apice bifido (sinu angustissmo) subalatis pedicello complanato plerumque longioribus; cotyledonibus incumbentibus. — Valley of the Pecos, in alluvial soil; May. Also sandy hills on the Rio Grande, near El Paso; March. (855.) — Plant 3 to 6 inches high, flowering when only an inch high, from an annual root. Fruiting racemes an inch long or more, dense. Silicles 2 lines long, twice as large as those of L. ruderale, beset with short and acute hispid spreading hairs; the short pedicel as broad and flat in proportion as in L. latipes, *Hook.* The low and spreading stems, the larger pods, which are decidedly wing-margined at the apex, and especially the short and flattened pedicels, distinguish this from L. ruderale var. lasiocarpum, *Engelm. in litt.* (coll. *Lindh.* 1850, No. 459, 460), which is perhaps L. lasiocarpum, *Nutt.*

L. intermedium (sp. nov.): similis L. Virginico formæ gracili, sed cotyledonibus incumbentibus! (foliis superioribus rameisque linearibus integerrimis). — Ravines of the Organ Mountains, northeast of El Paso; April. (1320). (Also near Austin, Texas, 1848; and New Braunfels, *Lindheimer?*) — This plant is exactly like a small and slender form of L. Virginicum; except that the upper leaves are nearly all linear and entire, and the cotyledons are incumbent. It is glabrous or nearly so; the white petals are perhaps rather larger and more conspicuous than in L. Virginicum; the stamens are only two; and the silicles are orbicular. On the other hand, it accords so perfectly with all the indigenous North American L. ruderale I possess (such, for instance, as Fendler's No. 45, except in having petals, that I cannot believe them to be specifically distinct. All these, however, differ from my specimens of L. ruderale from Europe in their orbicular (not *oval*) pods, of about twice the size.

CAPPARIDACEÆ.

Wislizenia refracta, *Engelm. in Wisl. Mem. N. Mex. p.* 15; *Gray, Pl. Wright. p.* 11. *t.* 2. Cleomella Coulteri, *Harvey, ined.* Sandy soil along the Rio Grande below and above El Paso; April, in flower; July, in fruit. Also between the Chiricahui Mountains and the San Pedro, Sonora. (856.)

Cleomella longipes, *Torr. in Pl. Wright. p.* 11. *adn.* Low, subsaline grounds, west of the Chiricahui Mountains, Sonora; Sept. (857.) — Stems 2 or 3 feet high, much branched from near the ground; the older racemes a foot long, loaded at the apex with light yellow flowers, and below with copious ripe capsules. These are triangular, turgid, the upper angles produced into a short horn. Stipe half an inch long, exceeding the pedicel. Seeds smooth, about ten in each pod.

Cleome Sonoræ (sp. nov.): annua, glabra, inermis; caule gracili erecto; foliis brevissime petiolatis trifoliolatis; foliolis anguste linearibus integerrimis, floralibus pedunculo patente subdimidio brevioribus; petalis albis mox roseis oblongis exunguiculatis sepala cuspidato-apiculata quadruplo superantibus; siliqua oblonga 6 – 7-sperma pendula thecaphoro longiore. — With the foregoing. — Stem 1 to 2 feet high, nearly simple. Lowest cauline leaves fallen; those extant have petioles of only a line in length, scarcely exceeding the minute and setaceous stipules; those of the upper and floral leaves still shorter, or almost wanting. Leaflets 5 – 8 lines long, a line or less in width, canaliculate or conduplicate in the specimens. Peduncles 6 – 9 lines long; the decurved stipe about 3 lines long in fruit. Petals about 2 lines long. Anthers 6, linear. Style very short. Pod torulose, about half an inch long, usually acute at both ends. Seeds smooth.

RESEDACEÆ.

Oligomeris glaucescens, *Cambess. in Jacq. Voy. Bot. p.* 24. *t.* 25. Reseda subulata, *Delile, Ill. Fl. Ægypt. p.* 15. Resedella subulata & R. dipetala, *Webb & Berth. Phyt. Canar.* 1. *p.* 107. *t.* 11. Ellimia ruderalis, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 125. Valley between the Salado and Lake Santa Maria, Chihuahua; April. (1321.) Also, Bolson de Mapimi, *Dr. Gregg.* California, *Coulter.*

VIOLACEÆ.

Ionidium lineare, *Torr.; Gray, Gen. Ill.* 1. *t.* 82. Base of the Organ Mountains, northeast of El Paso; April. Valley of the Limpio; June; — the ordinary Texan form. Also, gathered on the return, on the Pecos, a narrower-leaved form, approaching No. 21 of the former collection. (1322.)

I. riparium, *H. B. K. Nov. Gen. & Spec.* 5. *p.* 378; var. æstivum, cryptopetalum, pedicellis plerisque brevissimis. — Mountains east of Santa Cruz, Sonora; Sept. (859.) — The specimens are covered with ripe fruit; many of the pods are subsessile and clustered, and the petals are very small and nearly equal, like the later, cryptopetalous flowers of many violets. Root annual. — To I. riparium, placed in the wrong section by De Candolle, belongs his I. parietariæfolium, according to Mr. Bentham.

HYPERICACEÆ.

Hypericum formosum, *H. B. K. Nov. Gen. & Spec.* 5. *p.* 196. *t.* 160; *DC. Prodr.* 1. *p.* 547. Valleys near Santa Cruz, Sonora, in springy places; Sept. (860.) — This accords very closely with the description and figure of Kunth's species. It is the same as the H. Scouleri, *Gray, Pl. Fendl. p.* 11, from New Mexico. The Oregon plant has blunter sepals with scarcely any glands along their margins; but I suspect it is not specifically distinct.

ELATINACEÆ.

Elatine Americana, *Arn.; Gray, Gen. Ill.* 1. *p.* 220. *t.* 95. Margin of mountain streams near the copper mines, New Mexico; Oct.

CARYOPHYLLACEÆ.

Silene Greggii (sp. nov. Siphonomorpha): viscoso-pubescens; caulibus e radice perenni assurgentibus ramosis foliosis; foliis basi angusta sessilibus obovatis subacutis; pedunculis semper erectis calyce longe tubuloso clavato longioribus; petalis puniceis, lamina 4-fida, lobis lineari-lanceolatis, coronæ bipartitæ segmentis truncatis apice 3–4-dentatis; capsula cylindracea breviter stipitata. — Stony hills at the copper mines, New Mexico; Aug. (861.) (Mountains near Saltillo, *Gregg*, No. 223.) — Stems 1 to 2 feet long, usually glandular and viscid. Leaves 1 to 2 inches long, broadly obovate; the bracts oblong-lanceolate. Panicle several-flowered. Peduncles about an inch and a half, the calyx nearly an inch, in length. Lamina of the petals 8 lines long; the lobes entire, the middle ones somewhat larger than the lateral, but the sinuses of equal depth. Capsule an inch long, nearly included in the calyx. — Except in the form of the leaves, this plant differs little from what I take for Silene laciniata, *Cav.* (No. 723 of Coulter's Mexican collection; also gathered by Wislizenus, at Cosiquiriachi), to which Lychnis pulchra, *Cham. & Schlecht. Linnæa*, 5. *p.* 234, may apparently be referred.

S. Wrightii (sp. nov. Siphonomorpha): undique viscoso-pubescens, multiceps e caudice lignescente crasso; caulibus adscendentibus spithamæis foliosis; foliis oblongo-lanceolatis acuminatis sessilibus, inferioribus basi attenuatis; pedunculis subsolitariis erectis foliis brevioribus calyce fructifero clavato sæpius longioribus; dentibus calycis subulatis tubo vix dimidio brevioribus; petalis albis, lamina 4-fida, lobis lateralibus minoribus, centralibus 2–3-lobatis incisisve seu integris; coronæ segmentis ovatis integerrimis; capsula oblonga stipite paullo longiore. — In crevices of rocks, mountain-sides near the copper mines, New Mexico; Aug. to Oct. (862.) — This is a low, very glutinous-pubescent species, forming tufts from a thickened root; the weak and at length diffuse crowded stems from a span to a foot long. Leaves 2 inches long, thin; the lowest tapering into a margined petiole. Calyx 7 to 9 lines long. Lamina of the petals 3 lines long, sometimes nearly 4-cleft, often with the middle lobes incised.

Stellaria prostrata, *Baldw. in Ell. Sk.* 1. *p.* 518. Along the Limpio, near its head; June. (863.)

Arenaria diffusa, *Ell. Sk.* 1. *p.* 519. A. nemorosa, *H. B. K. Nov. Gen. & Spec.* 1. *p.* 35. Spergulastrum lanuginosum, *Michx.* Stellaria elongata, *Nutt.* S. lanuginosa, *Torr. & Gray, Fl.* 1. *p.* 187; *Gray, Pl. Fendl. p.* 13. Hills near the copper mines, New Mexico; and near Santa Cruz, Sonora. (864.) — This is a true Arenaria, as the genus is characterized by Fenzl. The petals, which are present in some of these specimens, are entire, and nearly as long as the calyx. This species extends southward to the Quitensian and the Peruvian Andes. The testa of the seed is very smooth and shining. In the nearly allied A. Benthamii, which Mr. Wright formerly gathered in Texas, the testa is tuberculate.

A. saxosa (sp. nov.): multiceps e radice perenni; caulibus subsimplicibus erectis (2–3-pollicaribus) foliosissimis puberulis; foliis oblongo-lanceolatis acutato-mucronatis uninerviis glabriusculis subcarnosis; pedunculis folia æquantibus; sepalis ovato-oblongis acutis margine scariosis carinato-uninerviis petalis brevioribus. — Stony hills at the copper mines, New Mexico; Aug. (865.) — Stems very numerous and tufted, erect, or somewhat spreading, very leafy, 1–5-flowered. Leaves 2 or 3 lines long, crowded, longer than the internodes, minutely scabrous-puberulent, scarcely ciliolate, thickish, rather strongly one-nerved. Peduncles simple, 2–4-lines long. Sepals about 2 lines long, a little shorter than the obovate-oblong white petals. Stamens 10: filaments glabrous. Styles 3. Ovary globose-ovoid, about 40-ovulate. Capsule rather longer than the calyx, 3-valved at the apex; the valves soon 2-cleft. Seeds rather numerous, smooth, not strophiolate. — The plant I named Mœhringia umbrosa in *Pl. Fendl. p.* 13, is probably a form of the present species, with a looser mode of growth, and with much longer and smoother leaves. I have no fruit of that plant. The present plant has estrophiolate seeds, and therefore cannot be a Mœhringia.

Cerastium vulgatum, *Linn.; Fenzl in Ledeb. Fl. Ross.* 1. *p.* 408. C. triviale, *Auct.* Ravines, on the Organ Mountains, New Mexico, April. (1323.)

Drymaria glandulosa, *Bartl. in Presl, Rel. Hœnk.* 2. *p.* 9. D. ramosissima, *Schlecht. in Linnæa*, 12. *p.* 206? D. cordata? *Gray, Pl. Fendl. p.* 13. New Mexico near the copper mines; Aug. and Oct. (866.) — Distinguished from D. cordata by the viscid-glandular pubescence of the branches, pedicels, and calyx; the more glomerate flowers; and the longer, sharply acuminate sepals. The specimens stick to the paper in which they were dried. The stamens are only 3.*

* No. 722 of Coulter's Mexican collection can hardly be separated with propriety from this genus, although it has entire petals and axillary flowers. It may be characterized as follows: —

Drymaria xerophylla (sp. nov.): glabra; caulibus decumbentibus ramisque floridis foliosis; foliis subsessilibus ovatis cuspidato-acuminatis chartaceo-membranaceis siccis 3–5-plinerviis venosis; stipulis plurisetosis; cymulis axillaribus 1–5-floris subsessilibus folia haud superantibus; sepalis oblongis obtusis 3-nerviis; petalis minimis spathulatis integris; ovario 3-ovulato. — The petals, which are not half the length of the sepals, are quite entire, or barely emarginate, or rarely one or two of them 2-lobed at the apex; they appear to be hypogynous. The stamens are only 3, with their filaments dilated at the base and connate into a ring. Capsule three-valved, one-seeded; the seed smooth. Embryo as in the genus. Leaves 3 to 5 lines in length.

D. polycarpoides, *Pl. Fendl. l. c.*, is, I believe, not distinct from D. crassifolia, *Benth. Bot. Voy. Sulph.*, which is the species inadvertently referred to under the name of D. glauca.

D. SPERGULOIDES, *Gray, Pl. Fendl. p.* 11. Stony hills, at the copper mines, New Mexico; Aug. and Oct. (867.) — The autumnal specimens, more branched, and loaded with fruit, have the pedicels all erect. The seeds are nearly smooth.

D. TENELLA, *Gray, Pl. Fendl. p.* 12. Banks of mountain torrents, near the copper mines, New Mexico; Aug., in flower; and on hill-sides under bushes, in fruit, Oct. (868.) — The young specimens are depauperate, only two inches high, with the spatulate-oblong or linear leaves 2 or 3 lines long. The later specimens are 3 or 4 inches high; the principal length of the stem of one almost capillary internode, which is often 2 inches long; the leaves very narrow and 6 lines long. The cyme effuse and many-flowered; the central pedicels all much shorter than the calyx. Capsule about the length of the calyx. Seeds very minutely roughened.

D. EFFUSA (sp. nov.): annua, glaberrima, nisi internodiis supra medium glandulosis viscosis; caule filiformi superne ramoso in cymam patentissimam multifloram diliquescente; foliis anguste linearibus sessilibus imis spathulatis parvis; pedicellis bracteas ovatas scariosas vix excedentibus flore brevioribus; sepalis ovatis obtusis 3-nerviis leviter scarioso-marginatis petalis alte bifidis (lobis oblongis) brevioribus capsulam 3 – 4-spermam adæquantibus; seminibus læviusculis. — Mountains east of Santa Cruz, Sonora; Sept. (869.) — Stems 3 to 5 inches high, with repeatedly forked and spreading branches. Leaves much shorter than the internodes. Calyx barely a line in length. Petals considerably exserted, and also larger and broader than in D. tenella. Stamens 5. Ovary subsessile, 5 – 7-ovulate. — Distinguished from the preceding by the viscous glandulosity of the upper half of all the internodes (except the very short pedicels), by the larger petals, &c.; from D. nodosa, *Engelm.*, which exhibits the first-named character, by the considerably smaller flowers, with obtuse and not at all rigid sepals, which are no longer than the capsule.

SPERGULARIA RUBRA, *St. Hil.; Torr. & Gray, Fl.* 1. *p.* 175; — diffuse or prostrate and small-flowered forms. Low banks of the Rio Grande at San Elizario; June. (1324.)

MOLLUGO VERTICILLATA, *Linn.* Hills near the copper mines, New Mexico; Aug.

PARONYCHIA JAMESII, *Torr. & Gray, Fl.* 1. *p.* 170; *Pl. Wright. no.* 27. *p.* 13. Hills of the San Pedro; May. On mountains near El Paso; April. (870.) Also on stony hills of the Pecos; July; — a slender and smoother variety, approaching P. Lindheimeri, but with a ligneous perennial root. (1325.)

P. LINDHEIMERI, *Engelm. in Pl. Lindh.* 2. *p.* 152. Hills of the Pecos; July. (1326.)

PORTULACACEÆ.

SESUVIUM PORTULACASTRUM, *Linn.* var. floribus subsessilibus. (S. sessile, *Pers.*) Low bottoms of the Rio Grande below El Paso. (871.) — Inner face of the sepals, and the stamens, bright red.

PORTULACA LANCEOLATA, *Engelm. in Pl. Lindh.* 2. *p.* 154. On the Rio Grande, and west of the copper mines, New Mexico; Aug. (872.)

P. RETUSA, *Engelm. l. c. & Pl. Wright. p.* 13. Doña Ana, New Mexico; July. — "Petals small, yellow, slightly emarginate."

P. PILOSA, *Linn.;* var. diffusa, floribus parvis. From the Limpio to the copper mines, New Mexico. (873.) — Var. erecta, floribus capsulisque magnis, petalis aurantiacis siccate rubris. Near the copper mines, New Mexico. (874.)

TALINUM PARVIFLORUM (*Nutt. in Torr. & Gray, Fl.* 1. *p.* 197; *Gray, Pl. Fendl. p.* 14): humile; staminibus 5; calyce tardius deciduo; capsula ovali; petalis pallide roseis vel lilacinis; cæt. fere T. teretifolii. — Stony hills at the copper mines; Aug. (871.) Also near El Paso; April.

T. AURANTIACUM, *Engelm. & Var. β.* ANGUSTISSIMUM, *Gray, Pl. Wright. p.* 14. Western Texas to the Pecos; also, in 1852, between the Limpio and the Rio Grande. (876.) — According to Mr. Wright, there are two forms of this species, which in the living plant appear quite distinct; the one, with copper-colored flowers, being more succulent, and usually with purple stems; the other has pale-yellow flowers, and usually narrower leaves. The dried specimens cannot be satisfactorily distinguished.

T. REFLEXUM, *Cav. Ic.* 1. *p.* 1. *t.* 1; *DC. Prodr.* 3. *p.* 357. T. spathulatum, *Engelm. in Pl. Wright. p.* 14. Rocky banks of Providence Creek, Rock Creek, &c., between the Limpio and the Rio Grande; June. (1327.) — Leaves mostly broader than in Wright's No. 35. "Flowers yellow. Stems spreading or decumbent."

TRIANTHEMA MONOGYNA, *Linn.* Fields near El Paso; July.

MALVACEÆ.

CALLIRRHOE INVOLUCRATA, *Gray, Pl. Fendl. p.* 15, *& Gen. Ill.* 2. *t.* 117. On the San Pedro and Pecos; May. (877.)

C. DIGITATA, *Nutt.; Gray, l. c.* Prairies of the Hondo, Texas; May. (878.)

C. PEDATA, *Gray, l. c.* (excl. syn.), *& Pl. Wright. p.* 15. Margin of thickets, from the Hondo to the Sabinal; May.

C. PEDATA, var. minor, floribus parvulis pallidis. Along the San Pedro; May. (879.)

SIDALCEA MALVÆFLORA, *Gray, Pl. Wright. p.* 16. Along the Mimbres, New Mexico; Aug. (880.)

MALVASTRUM COCCINEUM, *Gray, Pl. Fendl. p.* 24, *& Pl. Wright. p.* 16. West of the Limpio; June. (881.)

M. LEPTOPHYLLUM, *Gray, Pl. Wright. p.* 17. Stony hills, Escondido Springs, Western Texas; June. Prairies, from Santa Barbara to the copper mines, New Mexico; July. (882.)

M. PEDATIFIDUM, *Gray, Pl. Wright. p.* 17; forma humilis; ramis floridis simpliciusculis in racemum majus elongatum strictum abeuntibus; segmentis foliorum parce incisis vel subintegris. — Stony hills near El Paso; and in the valley of the Salado, Chihuahua; April. (1328.) — This is an earlier and simpler state of the species than Mr. Wright's No. 42; usually with larger flowers; the strict and naked racemes often 6 inches long. The lowest leaves are ovate or roundish in circumscription, and pedately 3 – 5-lobed. The Chihuahua specimens are more scurfy, and their flowers more purple.

Sphæralcea hastulata, *Gray, Pl. Wright. p.* 17. Valley of the Pecos, in alluvial soil; June. Sandy valleys of the Mimbres Mountains; Aug. (883.)

S. Fendleri, *Gray, Pl. Wright. l. c.;* var. foliis subtus plerumque subcanescentibus. On the Mimbres; and mountain-sides near the copper mines; July. (884.)

S. incana, *Torr.*, var. dissecta, *Gray, Pl. Wright. l. c.* Hill-sides, at Conde's Camp, west of the copper mines, New Mexico; Aug. (885.)

S. incana? var. oblongifolia: foliis inferioribus ovatis, superioribus ramcisque oblongis vel lanceolatis, omnibus pl. m. trilobis lobo medio elongato vel subhastatis dentatis furfuraceo-canescentibus (2–3-pollicaribus). — Banks of the Rio Grande near San Elisario; April. (1329.) — A puzzling form, manifestly inclined to run into the following, some specimens of which have the lower leaves hastately somewhat 3-lobed.

S. angustifolia, *Spach;* var. foliis lanceolatis, inferioribus nunc hastato-subtrilobatis! Alluvial soil on the Piedra Pinta, Western Texas; and around El Paso; July. (886.)

S. angustifolia, var. floribus et fructibus minoribus, *Gray, Pl. Wright. p.* 21. Between Providence Creek and the Rio Grande; June. (887.)

S. Wrightii (sp. nov.): pube laxa canescenti-tomentosa, sesquipedalis; caulibus e basi suffrutescente plurimis simplicibus apice longe racemoso-floriferis; foliis cordato-rotundis longe petiolatis, radicalibus inciso-sublobatis crenatis, caulinis 3–5-fidis pedatisve, lobis cuneatis crenato-dentatis; capsula 12–15-cocca calyce æquilonga, coccis mucronulatis dispermis. — On a mountain, near Lake Santa Maria, Chihuahua, April; chiefly in fruit. (1330.) — This species has much the habit of a Sidalcea, having mostly simple and virgate stems, long-petioled leaves with rounded cordate outline, and nearly naked, racemose inflorescence. It is from 8 to 20 inches high; the leaves about an inch in diameter, shorter than their petioles. Petals apparently purple, 4 or 5 lines in length. Capsule large in proportion, 3 lines long, ovoid-subglobose, with the apex truncate.

Sida hederacea, *Torr. in Pl. Fendl. p.* 23; *Gray, Pl. Wright. p.* 18. Bottoms of the Rio Grande below El Paso; May, June. (888.)

S. lepidota, *Gray, Pl. Wright. p.* 18. Around prairie-dog holes, between Providence Creek and the Rio Grande; June. Sandy valleys of the Mimbres Mountains; July. (889.) "Corolla light yellow."

S. lepidota, var. sagittæfolia, *Gray, l. c.* Plains, from Escondido Creek to the Pecos; June. (1331.) — Much finer specimens than those gathered in 1849 (No. 47); all with the same long and narrow leaves, with 2 or 3 sharp lobes at the base.

S. longipes, *Gray, Pl. Wright. p.* 19. Rocky hills, from Live Oak Creek, Texas, to the Pecos. (890.)

S. Elliottii, *Torr. & Gray, Fl.* 1. *p.* 232? var.? humilis; floribus minoribus. — Between the Limpio and the Rio Grande; and on mountains at the copper mines, New Mexico; Aug. — A dwarf perennial with "deep yellow petals." There is no mature fruit. The carpels appear to be muticous.

S. angustifolia, *Lam.; Cav. Diss.* 1. *p.* 14. *t.* 2. S. heterocarpa, *Engelm. in Pl. Lindh.* 2. *p.* 163. Prairies at Santa Cruz, Sonora; Sept. (891.)

S. FILICAULIS, *Torr. & Gray, l. c.* Live Oak Creek, Western Texas. (1332.)

S. FILICAULIS, *Torr. & Gray;* var. SETOSA: ramis adscendentibus pedunculis calycibusque pilis longis patentissimis setosis. — Bottoms of the San Pedro, Texas; May. Between Santa Barbara and the copper mines, New Mexico; July. (892.) — In *Pl. Lindh.* 2. *p.* 163, I have alluded to the slender hairs which beset the young stems of S. filicaulis; but in the present specimens they are vastly more conspicuous, and the stems are less procumbent; so that, at first sight, they would be taken for a different species. Dr. Gregg gathered this form in Chihuahua, and at Monterey. It is very likely to be the Sida diffusa, *H. B. K.*, the branches of which are said to be "molliter pilosi"; for, although the corolla is yellow, they often turn purplish in drying.

S. PHYSOCALYX, *Gray, Pl. Lindh.* 2. *p.* 163, & *Pl. Wright. p.* 20. Prairies of Western Texas; May.

ANODA PENTASCHISTA (sp. nov.): scabrido-pubens; foliis subtus cinereis, infimis cordatis, caulinis hastato-trilobis, summis hastato-lanceolatis vel linearibus pedunculo brevioribus; petalis flavis integerrimis lacinias calycis triangulares acuminatas paullo superantibus; capsula vix depressa 5-carpellari mutica calycem æquantibus. — Valley between Ojo de Gavilan and Conde's camp, beyond the copper mines, New Mexico; Aug. (893.) — Root annual. Stem erect, paniculately branched, 1 or 2 feet high. Leaves an inch to an inch and a half long, more or less toothed; the upper successively becoming lanceolate or linear, but always more or less hastate-lobed at the base, 5 to 12 lines long. Flower only 3 lines long! Calyx cinereous-pubescent like the lower surface of the leaves, not much spreading even in fruit, in length scarcely equalling the capsule. Corolla bright yellow; the obovate petals only about 2½ or 3 lines in length. Ovary 5-celled, with a solitary resupinate ovule in each cell. Capsule puberulent, somewhat 5-lobed, only moderately flattened at the top; the 5 carpels opposite the sepals, obscurely umbonate on the back; the dissepiments entirely evanescent, while the broad dorsal portion of each carpel is wrapped, in the manner of the genus, half round the turgid seed. — Although the fruit is only pentacarpellary, and little depressed, its whole structure and dehiscence are the same as in Anoda, with which the foliage likewise accords. The only character left to distinguish Anoda from Sida is the obliteration of the dissepiments of the fruit.

A. WRIGHTII (sp. nov.): caulibus pedunculis petiolisque scabro-pubescentibus et viscosis; foliis glabriusculis obtusis, infimis ovatis grosse crenatis, cæteris oblongo-ovatis seu triangulato-lanceolatis integris aut vix subtrilobis basi haud cordatis; pedunculis folium superantibus; petalis flavis apice obsolete crenulatis calycis laciniis ovatis obtusiusculis duplo longioribus; capsula hirsuta 11 – 12-carpellari stellariformi calyce patentissimo paullo breviore; carpellis dorso crista calcariformi obtusa appendiculatis. — On the summit of mountains near the copper mines, New Mexico; Oct. (894.) — Root annual. Stems one or two feet high, with divergent branches, rough with a rather coarse and viscous pubescence. Leaves slightly if at all subcordate, green both sides, 10 to 18 or 20 lines long, obscurely if at all lobed, not hastate nor acuminate. Lower peduncles 1½ to 2 inches long; the upper about an

inch long. Sepals barely 3 lines long, united below the middle, triangular-ovate, not pointed, in fruit becoming 4 or 5 lines long, and appearing acuminate by the involution of the edges towards the tip. The fructiferous calyx is as widely spreading as in A. hastata. Petals about 5 lines long, yellow, the nearly truncate summit obscurely erose-crenulate. Fruit depressed and stellariform, as in the genus generally, about 5 lines in diameter, very hirsute, usually of 11 carpels; each of them produced on the back into an appendage as long and conspicuous as in many specimens of A. hastata (*Gen. Ill.* 2. *t.* 124), but broader and more spur-shaped. Seed as in the other species. — I have not seen A. crenatiflora, *Ort.* (A. parviflora, *Cav.*); but judging from the description, and from the figure of Cavanilles, our species is to be distinguished by its undivided and not cordate leaves, its glutinous pubescence, its longer peduncles, its petals about twice the length of the calyx, the obtuse lobes of the latter, and the manifest dorsal appendage of the carpels. A. pubescens, *Schlecht.* is said to have deeply cordate and sharply acuminate leaves, very acutely acuminate sepals, and muticous carpels. The character of A. lanceolata, *Hook. & Arn.* (of which the corolla is doubtfully said to be yellow), accords better with our plant; but that has the leaves velvety underneath, and the petals (nine lines long) thrice the length of the calyx.

A. HASTATA, *Cav. Diss.* 1. *t.* 11. *f.* 2; *Gray, Gen. Ill.* 2. *t.* 127; var. depauperata, floribus parvis. — Mountain valleys at the copper mines, New Mexico, and near Santa Cruz, Sonora; Aug., Sept. (895.) — Another small-flowered form of this, or perhaps a different species, was sparingly gathered, in flower only, in valleys of Chiricahui Mountains.

ABUTILON WRIGHTII, *Gray, Pl. Wright. p.* 20. Rocky hills, from Escondido Creek to Comanche Spring, Western Texas; June. (896.)

A. TEXENSE, *Torr. & Gray, Fl.* 1. *p.* 231; *Gray, Pl. Wright. p.* 21. Alluvial soil, from the Piedra Pinta to the Pecos, Texas; May, June. (897.)

A. PARVULUM, *Gray, Pl. Wright. l. c.* Stony prairies, Comanche Spring and Chicon Creek, Texas; May. Also between the Limpio and the Rio Grande. (898.)

A. SONORÆ (sp. nov.): caule erecto petiolisque pilis longis patentissimis hirsutis; foliis rotundo-cordatis acuminatis subtrilobis crenatis vel duplicato-dentatis 7–9-nerviis supra velutino-puberis subtus mollissime cano-tomentosis; stipulis caducissimis; floribus laxe paniculatis parvulis; pedunculis plurifloris; calycis laciniis ovatis acutiusculis petalis flavis capsulaque puberula apice truncata dimidio brevioribus; carpellis 7 – 11 chartaceis mucronatis trispermis. — Hill-sides on the Sonoita, in the northern part of Sonora; Sept. (899.) — Stem 1 to 4 feet high, herbaceous, somewhat branched, below densely, above more sparsely hirsute, as well as the petioles, with shaggy and rather stiff spreading hairs. Leaves 3 or 4 inches in diameter, the deep sinus nearly closed. Floral leaves very small; the large and loose terminal panicle nearly naked. Peduncles mostly several-flowered, nearly glabrous. Pedicels articulated towards the summit. Petals only 3 lines long. Capsule 4 or 5 lines long, fully twice the length of the calyx; the carpels not inflated, their apex dorsally tipped with a short and abrupt mucro.

HIBISCUS (BOMBICELLA) DENUDATUS, *β.* INVOLUCELLATUS, *Gray, Pl. Wright. p.* 22.

Mountains, between the copper mines, New Mexico, and Santa Cruz, Sonora; Sept. (900.)

H. (Bombicella) Coulteri, *Harv. in Pl. Wright. l. c.* With the preceding. (901.)

Pavonia Wrightii, *Gray, Gen. Ill.* 2. *t.* 130, *& Pl. Wright. p.* 72. Between the Leona and the Sabinal, Western Texas. (1333.)

BYTTNERIACEÆ.

Melochia pyramidata, *Linn.* Margin of a stream at Painted Caves, on the San Pedro, Western Texas; July. (1334.)

Hermannia Texana, *Gray, Gen. Ill.* 2. *t.* 135, *& Pl. Wright. p.* 34. Stony prairies of Chicon Creek, Western Texas; May. (902.)

Ayenia pusilla, *Linn.* var., *Gray, Pl. Wright. p.* 24. *no.* 645. Rocks between Eagle Springs and the Limpio; June. Also (with still narrower leaves) in Sonora, between the Chiricahui Mountains and the San Pedro; Sept. (903.) — The fertile stamens adhere to the petals and come away with them. The anthers are not bilocular, as the genus is described, but trilocular!

A. microphylla (*Gray, l. c.*): foliis cordato-rotundis; floribus in axillis solitariis breviter pedicellatis; petalorum lamina absque glandula dorsali; tubo stamineo brevissimo cyathiformi; antheris fertilibus (trilocularibus!) sessilibus sterilibus difformibus brevioribus; ovario haud stipitato. — Rocky ravines near Frontera, New Mexico; May: in flower and fruit. (1335.) — I have completed the character of the species from the flowering specimens gathered in the spring of the present year. The flowers are smaller than in A. pusilla; and the (dark red) petals have shorter claws. The lamina of the latter, when outspread, has nearly the shape of the leaf of Liriodendron; the two terminal angles are pointed and apparently glandular at the tips, by which they adhere to the column; the notch bears an apical acumination which is strongly recurved, but is not produced into a gland, nor is there any such dorsal appendage as in A. pusilla. The very short and cup-shaped stamineal column is terminated by five thick lobes, or deformed sterile anthers, alternating with the petals and much larger than the fertile anthers; they are somewhat two-lobed, like an ordinary anther, and bear a strongly reflexed and acuminate apical appendage, like that of the petals. The fertile anthers are sessile in the sinuses, and consist of *three* oval parallel cells, opening longitudinally. The ovary and capsule are nearly as in A. pusilla, except that they are not raised on a stipe. The obovate seeds are rugose-corrugated.

Waltheria detonsa (sp. nov.): pube brevissima cinereo-tomentulosa; caulibus e basi lignescente plurimis gracilibus; foliis ovalibus denticulatis haud plicatis; glomerulis axillaribus breviter pedunculatis; calycibus et ovario canescentibus (haud villosis). — Rocky hills on the Sonoita, near Deserted Rancho, Sonora; Sept. (904.) — The slender stems are a foot or less in height; the leaves about an inch long, not plicate-veined nor velvety like those of W. Americana; the heads are also smaller, and the calyx not all hirsute-villous. Mr. Bentham informs me that he has apparently the same species from British Guiana; No. 497 of Rob. Schomburgk's second collection, and No. 761 of Rich. Schomburgk.

LINACEÆ.

Linum perenne, *Linn.* Valley of the Pecos, Limpio, &c.; very common. (905.)

L. rupestre, *Engelm. in Pl. Lindh. 2. p. 232, & Pl. Wright. p. 26.* Crevices of rocks on the Sabinal. (1336.)

L. rigidum, *Pursh, Fl. 1. p. 210.* L. puberulum, seu rigidum var. puberulum, *Engelm. in Pl. Wright. p. 25.* Stony hills near the Rio Grande above El Paso; April. (1337.) — These fine flowering specimens have the bright yellow petals (deeper-colored next the base) half an inch or more in length, and therefore nearly as large as those of L. Berlandieri. From this it is distinguished by its glaucescent appearance, its more subulate erect leaves, and especially by the whole face of the dissepiments being excessively thin and hyaline, — a character pointed out by Dr. Engelmann. Stipular glands are not unfrequently visible.

L. aristatum, *Engelm. in Wisliz. Mem. N. Mex. p. 101; Gray, Pl. Wright. p. 26.* Sandy hills on the Rio Grande near El Paso; April. (1338.) — Petals 4 or 5 lines in length, light yellow.

OXALIDACEÆ.

Oxalis dichondræfolia, *Gray, Pl. Wright. p. 27.* Shady bottoms of the San Pedro, Western Texas; May. (906.)

O. Wrightii, *Gray, l. c.* Painted Camp, near the head of the Limpio. Also, in 1852, on Rainwater Creek and Rock Creek; June. (907.) — One of the forms in the collection of 1852 is dwarf; the other is fully as large as the specimens gathered in 1851. The peduncles, often an inch and a half long, are more commonly 2-flowered; and one of the pedicels is occasionally bibracteolate in the middle. Mr. Wright informs me that the petals are yellow.

O. violacea, *Linn.* Stony hills at the copper mines, New Mexico; Aug. (908.) — A small-flowered variety, the same as No. 91 of Fendler's collection, which was erroneously called O. vespertilionis in *Pl. Fendl. p. 27.* The latter name, being preoccupied by Zuccarini, must be replaced by that of O. Drummondii.

O. decaphylla, *H. B. K. Nov. Gen. & Spec. 5. p. 238. t. 468; Zucc. Mon. Oxal. no. 26, & Nachtr. Oxal. p. 41.* Stony hills at the copper mines, New Mexico; Aug. (909.) — Leaflets 6 to 8, or rarely only 3 in depauperate specimens. The flowers accord with Zuccarini's character, rather than Kunth's; for the "purple" flowers are twice the size of those of O. stricta; the filaments are glabrous and shorter than the styles, which are hirsute. There is probably a sexual dimorphism.

GERANIACEÆ.

Geranium cæspitosum, *James; Gray, Pl. Fendl. p. 25.* Hill-sides, Mule Creek and Coppermine Creek, New Mexico; Aug. (910.) — Varieties with shorter peduncles, and mostly with larger leaves, than in Fendler's specimens.

G. Carolinianum, *Linn.* Banks of Lake Santa Maria, Chihuahua; April; just coming into flower.

Erodium Texanum, *Gray, Gen. Ill. 2. t. 150.* Hills above El Paso, April. (1339.)

ZYGOPHYLLACEÆ.

KALLSTRŒMIA GRANDIFLORA, *Torr. in Pl. Wright. p.* 28. Near Ojo de Gavilan, beyond the copper mines, New Mexico; Aug. (911.) — The same as Coulter's and Emory's specimens. Leaflets often 6 pairs. Flowers very large and showy.

K. MAXIMA, *Torr. & Gray*, — a depauperate variety. East of the Rio Grande, New Mexico; June. (912.)

LARREA MEXICANA, *Moricand; Gray, Pl. Wright. p.* 28. Bottoms of the San Pedro, Western Texas; May. (913.)

RUTACEÆ.

KŒBERLINIA SPINOSA, *Zucc.; Gray, Pl. Wright. p.* 30. East of the Rio Grande, New Mexico; June, in flower. (914.)

RUTOSMA TEXANUM, *Gray, Gen. Ill. t.* 155, *& Pl. Wright. l. c.* Stony prairies of the Sabinal, and near Comanche Spring, Western Texas; May, June. (915.) — Corolla dull yellow.

R. TEXANUM, var. corolla purpurea! Hills near El Paso; April. Mountains near Santa Cruz, Sonora; Sept. (915ª.) — All the specimens from about El Paso and westward are said to have purple flowers, and they are purplish in the dried specimens. They are yellow in Gregg's specimens from Monterey.

COCHLOSPERMEÆ.

AMOREUXIA SCHIEDEANA, (*Planch. in Hook. Lond. Jour. Bot.* 6. *p.* 140. *t.* 1; non *Gray, Pl. Wright.*): foliis 7 – 9-partitis, segmentis spathulatis; fructu ovoideo-globoso pollicari; seminibus reniformi-curvatis, tegumento externo tenui hispidulo interiori conformi; embryone homotrope incurvo. (Tab. XII. A.) — Euryanthe Schiedeana, *Cham. & Schlecht. in Linnæa*, 5. *p.* 225. Amoreuxia palmatifida, *DC. Prodr.* 2. *p.* 638? (Mexico, *Schiede. Coulter!* (Sonora Alta). New Granada, *Purdie!*) Hills along mountain streams, near Deserted Rancho, in the northern part of Sonora; Sept. (916.) — The specimens are chiefly with ripe fruit; the pods ovoid-globose, barely an inch long, and therefore only half, or less than half, the size of those of Mr. Wright's former specimens (No. 79), figured in *Pl. Wright. t.* 3, *B.* A more remarkable difference is found in the seeds, which in the present specimens are strongly incurved-reniform, with the fragile exterior integument conformed to the inner one, and beset with minute hispid hairs; and the embryo is simply curved, without any double flexure. The lobes of the leaves, also, are more numerous and narrower. I cannot doubt that these specimens belong to the species characterized by Chamisso and Schlechtendal (who describe the pod as scarcely an inch long and ovoid-globose, the seeds as reniform? and the leaves as 5 – 9-parted). It is certainly the plant recently figured by Planchon.

A. WRIGHTII: foliis 5-partitis vel sub-7-partitis, segmentis obovatis basi cuneatis; fructu oblongo-ovoideo (sæpius bipollicari); seminibus obovoideis haud incurvis, tegumento externo laxo arilliformi glabro; embryone biarcuato. — A. Scheideana, *Gray, Pl. Wright. p.* 29. *t.* 3. *B.*, excl. syn. — Hills at Painted Caves, near the San

Pedro River (the same locality as that of No. 79); July: with young fruit. (1340.) — These few specimens were gathered on the return journey, the past summer. They resemble those of the collection of 1849, the unripe pods being an inch and a half long; except that one or two stunted plants have ripened pods which are no larger than those of the preceding species; but their seeds, &c. exactly resemble those figured in *Plantæ Wrightianæ*. — The specimens gathered by Dr. Gregg and Dr. Edwards near Monterey appear to belong to this species, but they show no fruit.

ANACARDIACEÆ.

Rhus virens, *Lindh. in Pl. Lindh.* 2. *p.* 159. Along mountain streams on the Sonoita, Sonora; Sept. — The specimens, mostly in fruit, resemble the Texan plant.*

R. (Lobadium) microphylla, *Engelm. in Pl. Wright. p.* 40. Stony hills near El Paso, March, in flower, before leafing; also on the San Pedro, Western Texas, July, in fruit, and with smaller leaves than in the specimens of 1849. (1341.)

R. trilobata, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 219; *Gray, Pl. Wright. p.* 31. Pebbly banks of the San Pedro, Western Texas; May, in fruit. (917.) — Var. molliter tomentosa. Organ Mountains, New Mexico, and toward the Limpio; April, June: in fruit. (1342.)

VITACEÆ.

Vitis rupestris, *Scheele in Linnæa*, 21. *p.* 591; *Gray, Pl. Lindh.* 2. *p.* 165. Pebbly bottom of the San Pedro; and hill-sides on the Limpio; May, June: in fruit. (918.) — "Climbing 8 – 10 feet."

V. æstivalis, *Michx. Fl.* 2. *p.* 230; var. Banks of Elm Creek, Texas; climbing on trees, July; in fruit. — The same form as Lindheimer's No. 359.

V. æstivalis, *Michx.*; var.? foliis parvis. Ravine at Santa Cruz, Sonora; Sept.; in fruit. (919.) "Climbing on small trees 8 or 10 feet high."

RHAMNACEÆ.

Zizyphus lycioides, *Gray, Pl. Lindh.* 2. *p.* 168, & *Pl. Wright. p.* 32. Between Western Texas and El Paso, the locality not recorded; in flower. (920.) Also on rocky hills opposite Frontera, New Mexico, March, in young fruit; and May, with ripe fruit. (1343.)

Z. obtusifolia, *Gray, Gen. Ill.* 2. *t.* 163, & *Pl. Lindh. l. c.* Prairies between the Rio Grande, New Mexico, and Eagle Spring; June. (1344.)

Condalia spathulata, *Gray, Pl. Wright. p.* 32. Sides of a cañon on the San Pedro, Sonora; Sept. (921.) — "Shrub 4 – 6-feet high, much branched; flowers greenish-yellow." Leaves 2 or 3 lines long, crowded and fascicled.

C. obovata, *Hook.*, var. foliis parvis. Hills of the San Pedro and Zoquete Creek, Western Texas; July. (1345.)

* Pistacia Mexicana, *H. B. K.* was gathered by the late Dr. Gregg, near Monterey and Rinconada.

Microrhamnus ericoides, *Gray, Pl. Wright. p.* 34. Prairies between Howard's Creek and Live Oak Creek, Western Texas, May; also between the Limpio and the Rio Grande. (922.) — The specimens are loaded with the fruit, which has been described in the account of Mr. Wright's former collection.

Karwinskia Humboldtiana, *Zucc.; Gray, Pl. Wright. p.* 32. Limestone hills in the Big Bend of the San Pedro River, Western Texas; July. (1346.)

Adolphia infesta, *Meisner; Gray, Pl. Wright. l. c.* Mountain valleys between the Limpio and the Rio Grande, June; in flower. (923.)

Frangula Californica, *Gray, Gen. Ill.* 2. *p.* 178; var. tomentella. Rhamnus tomentellus, *Benth. Pl. Hartw. p.* 303. Ojo de Gavilan, beyond the copper mines, New Mexico; Aug. (924.) "Shrub 4 to 6 feet high." — In these specimens the leaves are glabrous and bright green above, even when young, but are clothed beneath, as are the branchlets, with a fine and soft whitish pubescence. They are mostly serrulate, as they also are in my specimen of Hartweg's No. 1686. From Fremont's Californian collection, Dr. Torrey has specimens still more tomentose, even on both sides of the leaves; but I think that all these are merely varieties of Hooker's Rhamnus oleifolius, which was earlier published by Eschscholtz, under the name of Rhamnus Californicus.

Sageretia Michauxii, *Brongn.; Gray, Gen. Ill.* 2. *t.* 166. Rocky banks, east of Santa Cruz, Sonora; Sept. (925.) — The specimens, which are sparingly in flower, appear to agree in all respects with those from Florida. I am not aware that this species has been yet observed at any intermediate station.

Ceanothus Greggii (sp. nov.): divaricato-ramosissimus; ramulis tomentoso-puberulis; foliis confertis ellipticis oblongisve integerrimis coriaceis crassis uninerviis glabellis subtus leviter penninerviis primum tomentulosis (3 – 5 lin. longis); pedicellis pubescentibus (demum glabratis) flore albo paullo longioribus. — (Battle-field of Buena Vista, *Gregg;* in flower.) Side of mountains near Frontera, New Mexico, July; in fruit. — Shrub 2 – 5 feet high, with very rigid branches. Pedicels shorter than the leaves. Flowers small. Fruit about 2 lines in diameter. — I have only poor specimens of this species. It bears considerable resemblance to small-leaved forms of C. cuneatus, *Nutt.;* but the leaves are not narrowed towards the base, and the pinnate veins underneath are obscure.

CELASTRACEÆ.

Mortonia sempervirens, *Gray, Pl. Wright. p.* 35. *t.* 4. Stony prairies, San Felipe Creek, Western Texas; May. (926.) — The flower, in all the species, is articulated with the peduncle, just above the pair of bracts.

M. scabrella (sp. nov.): fruticosa; foliis obovatis ovalibusve margine incrassatis undique ramulisque hispidulo-scabris; petalis et disco margine fere integerrimis; calyce fructu ovali-oblongo dimidio breviore; stylo breviusculo. — Mountain-sides, near the San Pedro, Sonora, Sept.; in flower and fruit. Mountains near El Paso, April; in flower. (927.) — Stems 2 to 4 feet high, much branched. Leaves 3 or 4 lines long, and 2 or nearly 3 lines wide, very obtuse, seldom mucronulate, very thick and with a thickened margin, rough with a short and close pubescence which

consists of very short bristly hairs from a papillose base. The flowers, &c. are nearly as in M. sempervirens; except that the petals are not crose-denticulate, but are minutely ciliolate under a lens, with a pubescence much like that of the leaves, though finer and apparently glandular, and which also covers their surface; the disk is not lobed nor manifestly repand; the fruit is rather shorter, and so is the style. The oblong cotyledons are, perhaps, less fleshy.

Schæfferia cuneifolia, *Gray, Pl. Wright. p.* 35. Stony prairies, from the San Felipe to the San Pedro, Western Texas; May, in fruit. (928.)

Pachystima Myrsinites, *Raf.; Gray, Pl. Fendl. p.* 29. Mountain-sides, at the copper mines, New Mexico; Oct., in flower. (929.)

GLOSSOPETALON, *Nov. Gen.*

Flores hermaphroditi. Calyx profunde 5-fidus, persistens; lobis ovatis obtusis æstivatione imbricatis. Petala 5, lineari-ligulata, calyce multo longiora, sub margine undulato-10-crenulato glanduloso disci tenuis perigyni inserta, marcescentia. Stamina 10, sinubus disci inserta, calyce breviora: filamenta subulata: antheræ didymæ, muticæ, filamento æquilongæ, loculis longitudinaliter dehiscentibus. Ovarium liberum, ovoideum, obliquum, apice acutum, stigmate sessili orbiculato depresso simplicissimo coronatum, uniloculare. Ovula 2, e basi fere loculi erecta, subcollateralia, anatropa. Fructus oblique ovoideus vel oblongus, apiculatus, coriaceus, multistriatus, 1–2-spermus, tandem bivalvis? Semen obovoideum, compressiusculum, hilo exciso arillo parvo carunculæformi bilobo munitum; testa lævi crustaceo. (Embryo haud visus.) — Frutex 2–4-pedalis, ramosissimus, glaber; ramis viridibus striatis spinescentibus; foliis alternis oblongo-linearibus spathulatisve integerrimis parvis, vel ramulorum florif. ad squamulas subulatas minimas reductis; stipulis nullis; floribus albis secus ramulos sparsis axillaribus breviter pedunculatis.

Glossopetalon spinescens. (TAB. XII. *B.*) — In a mountain ravine near Frontera, New Mexico; April. (1347.) — The general aspect of this singular shrub is so nearly that of Adolphia infesta, that it was mistaken for it by Mr. Wright, and therefore was only sparingly gathered, in flower, with a few immature fruits. It is to be hoped that the botanists of the Boundary Commission will yet obtain it in greater abundance and perfection. The detailed character given above will show that it belongs to an entirely new genus, and probably to the order Celastraceæ. To this order I venture to refer it, notwithstanding two decidedly exceptional characters, namely, the stamens of twice the number of the petals, and the strictly simple pistil. The fruit, which is probably dehiscent at maturity, is a good deal like one of the separate carpels of Euscaphis staphylæoides, although many times smaller (only two lines in length); and the seed resembles that of Staphylæa, except that it is appendaged at the hilum with a small, rather fleshy arillus. In these respects, therefore, (but in no other,) our plant appears to be intermediate between Celastraceæ and Staphyleaceæ. Ordinarily only one seed matures; but in a specimen gathered by Dr. Bigelow, two full-grown (superposed) seeds are occasionally found. In none have I found a perfect embryo. In the few seeds examined, there is a bulge of the crustaceous testa on each side, which corresponds to a defined

empty cavity underneath, separated by a firm partition from the central portion, which contains the scanty albumen and forming embryo. The leaves are 2 to 4 lines long, with a tapering base, dilated at the insertion; on many of the branches they are reduced to this base, the lamina being abortive. The narrow, strap-shaped petals are nearly 3 lines in length, about thrice the length of the very obtuse and slightly scarious-margined lobes of the calyx; they are inserted by a narrow base.

SAPINDACEÆ.

Ungnadia speciosa, *Endl.*; *Gray*, *Pl. Wright. p.* 38. Ravines of the Organ Mountains, New Mexico; April, in flower. — This has not before been found west of the Rio Nueces.

MALPIGHIACEÆ.

Galphimia linifolia, *Gray*, *Gen. Ill.* 2. *p.* 196. *t.* 173, & *Pl. Wright. p.* 36. From the Sabinal to the San Pedro, Texas; May. (930.)

Aspicarpa hyssopifolia, *Gray*, *Pl. Lindh.* 2. *p.* 167, & *Pl. Wright. p.* 36. Stony prairies, Chicon Creek, Western Texas, May; and on the San Pedro, July. (931.)

A. longipes, *Gray*, *Pl. Wright. p.* 37. Crevices of rocks, Wild Rose Pass, valley of the Limpio; June. Also, mountain valleys near Santa Cruz, Sonora; Sept. (932.) — In the later specimens, both carpels of the apetalous flowers often ripen.

Janusia gracilis, *Gray*, *Pl. Wright. p.* 37. Mountains, Guadalupe Pass, and heads of the Aqua Prieta, east of Santa Cruz, Sonora; Sept. (933.) — Some petaliferous flowers occur, which accord with the generic character. The petals are yellow, with a rounded and nearly entire lamina, raised on a slender claw. Fertile stamens 2 or 3.

POLYGALACEÆ.

Polygala alba, *Nutt.*; *Gray*, *Pl. Wright. p.* 38. Valley of Live Oak Creek, Texas; May. — A specimen or two of an abbreviated form occurs in the collection from Sonora.

P. scoparia, *H. B. K.*, var. multicaulis, *Gray*, *Pl. Wright. p.* 38. Mountains, Guadalupe Pass, Sonora; Oct. Also mountains near El Paso; April. (934.) Stems rather taller and more branched above than in No. 100 of Wright's former collection.

P. macradenia, *Gray*, *Pl. Wright. l. c.* Hills of Live Oak Creek, Texas; May. Stony hills near El Paso; March, May. (1348.)

P. Lindheimeri, *Gray*, *Pl. Lindh.* 2. *p.* 110, & *Pl. Wright. l. c.* Hill-sides on the Limpio, San Pedro, and Comanche Spring, Western Texas; May, June. (1349.)

P. ovatifolia, *Gray*, *Pl. Wright. p.* 39. Elm Creek, Western Texas, to the San Pedro; May. (935.)

P. puberula, *Gray*, *Pl. Wright. p.* 40. Stony ridges, and in the alluvion at their base, on the Pecos; May. (936.) Also near the copper mines, New Mexico; July.

P. (Monninopsis) hemipterocarpa (sp. nov.): glabra, perennis; caulibus gracilibus ramisque strictis striato-angulatis foliosis; foliis subulato-lincaribus uninerviis alternis; racemo virgato multifloro; floribus albis mox pendulis; carina cristata alis obovatis paullo breviore; capsula oblonga membranacea, loculo postico dupliciter alato inter laminas dehiscente, antico paullo minore indehiscente semen fere ecarunculatum includente. — Stony hills of the Sonoita, near Deserted Rancho, on the borders of Sonora. (937.) — Root perpendicular, perennial. Stems erect, sparingly branched above (the branches strict), slender, strongly striate-angled, 12 to 20 inches high. Leaves mostly erect, rather rigid, somewhat crowded, alternate, sessile; acute, seldom half a line wide; the lower cauline about 3 lines long; the upper and those of the branches 7 to 10 lines long. Raceme rather densely flowered, 2 or 3 inches in length. Bracts subulate-lanceolate, about the length of the short pedicels, very caducous. Calyx white or whitish; the three small sepals ovate, rather obtuse; the wings obovate, slightly unguiculate, rather longer than the corolla, one third shorter than the capsule. Lateral petals obovate, as long as the entire and hooded keel, not including its crest; which is nearly as in P. scoparia. Stamens 8, in two sets. Stigma cucullate and bilabiate; the short upper lip truncate and tipped with a small tuft of bearded hairs; the lower lip decurved, also somewhat truncate and ciliolate. Ovary equal-sided, two-celled, with a single ovule in each cell. Capsule thin and membranaceous, glabrous, oblong, obscurely emarginate, $2\frac{1}{2}$ lines in length, somewhat gibbous; the cell next the axis being rather larger than the other, and appendaged with a crenulate, bilamellar wing, reaching from near its base to the apex, dehiscent between the two laminæ; the valves then becoming outspread, so that they form, as it were, a broad, obcordate wing, surrounding the anterior cell (the one next the carina), which is indehiscent, conformed to the seed, and not at all winged or margined on its back. Seed cylindrical, hirsute with spreading hairs; that of the posterior cell with a conspicuous caruncle, the linear lobes of which are fully half the length of the seed; that of the indehiscent and anterior cell with the caruncle obsolete or rudimentary. — In general aspect, this species is intermediate between P. alba and P. scoparia; but taller than either. From the singular structure of the fruit, it must constitute a marked new section of the genus.

Monnina Wrightii (sp. nov.): annua, fere glabra; caule gracili; foliis lanceolatis linearibusve subsessilibus; floribus parvis mox deflexis hexandris; fructu sicco complanato inæqualiter ovato acutissime marginato uniloculari, faciebus uninerviis venulosis. — Crevices of rocks, mountain-sides, near the copper mines, New Mexico; Aug., in flower; Oct., in fruit. (938.) — The flowering specimens are about a span, the slender fruitful ones a foot or more, in height. Leaves one or two inches long, 2 to 4 lines wide; the very lowest small and obovate; the others acute. Raceme one or two inches long; sometimes there are other and very short racemes in the axils. Bracts minute. Flowers a line and a half long, greenish-white tinged with purple. Stamens 3 in each phalanx: filaments glabrous. Fruit deflexed, flattened, scarcely 2 lines long, with a sharp and wing-like margin, and the sides carinately one-nerved, minutely puberulent under a lens. Seed smooth, not carunculate.

KRAMERIACEÆ.

Krameria parvifolia, *Benth.*; *Gray, Pl. Wright. p.* 41. Valleys, between the Limpio and the Rio Grande, June; and on sand-hills near Frontera, July. (939.) — A dwarf variety of this, with more numerous glandular setæ on the peduncles, &c., was gathered between San Pedro and Santa Cruz, Sonora; Sept. (940.) — A few specimens of the var. ramosissima (no. 105), were gathered on the San Felipe.

K. canescens, *Gray, l. c.* Hills of Live Oak Creek, Texas; May. Also between Eagle Springs and the Rio Grande. (941.)

K. lanceolata, *Torr. in Ann. Lyc. New York*, 2. *p.* 168; verging to K. secundiflora, *DC.* Stony prairies of Chicon Creek, W. Texas. Near El Paso; May. (942.)

LEGUMINOSÆ.

Vicia pulchella, *H. B. K. Nov. Gen. & Sp.* 6. *p.* 499. *t.* 583? var. foliolis majoribus obtusis cuspidato-mucronatis; stipulis plerisque integerrimis. — Pine hills between the copper mines and the Mimbres, New Mexico; Oct., with mature fruit. (943.) (San Antonio de las Alanzanes, Mexico, *Gregg;* in flower and fruit.) — Dr. Gregg's specimen accords with Kunth's figure, except that most of the leaflets are obtuse. Ours, which are autumnal specimens, with ripe fruit, have rather larger and more rigid leaflets, and linear and entire stipules. The numerous pods are an inch in length, nearly 3 lines wide, somewhat falcate, acute, 6 – 10-seeded.

V. exigua, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 272. Ravines near El Paso; also on the banks of Lake Santa Maria, Chihuahua; April. (1350.) — The earlier peduncles are very short, while some of the later ones are almost as long as the leaf.

Lathyrus polymorphus, *Nutt.; Torr. & Gray, Fl. l. c.*; *Gray, Pl. Fendl. p.* 30. Along streams, between the San Pedro and Santa Cruz, Sonora; Sept. (944.)

L. linearis, *Nutt. in Torr. & Gray, l. c.* (L. dissitifolius, *Nutt. l. c.*); var. stipulis minimis subulatis integerrimis. Stony hills at the copper mines, New Mexico; Aug. (945.) — Flowers in the dried specimens blue-purple, especially towards the tip, three fourths of an inch long.

L. palustris, *Linn.*? var. foliolis elongatis angustis gramineis; stipulis minoribus, nunc semisagitatis, nunc subulatis integris. — Stony hills near the copper mines, and along Coppermine Creek; Aug. (946.) — I cannot distinguish this from American forms of L. palustris; and in some specimens the stipules are of the same shape as in that species. The flowers were purple, but have mostly lost their color in drying, as in Fendler's No. 116.

Cicer arietinum, *Linn.* New Mexico or Sonora (the locality not recorded); doubtless introduced.

Phaseolus retusus, *Benth. Pl. Hartw. p.* 11; *Gray, Pl. Wright. p.* 43. Valley of the Limpio; June. Sandy banks of the Mimbres, and near the copper mines, New Mexico; Aug. (947.) — "Prostrate. Root very large, 2 feet long, 5 inches thick at the crown, rather ligneous, astringent."

P. acutifolius, *Gray, Pl. Wright. p.* 43. Sides of the Chiricahui Mountains, Sonora; Sept. (948.) — The root is annual; the flowers purple or purplish.

P. ACUTIFOLIUS; var. foliolis majoribus ovatis acuminatis; legumine majore (3-pollicari). — Valleys of Sonora; Sept. (949.)

P. ACUTIFOLIUS, var. TENUIFOLIUS: gracilis; foliolis lanceolatis e basi pl. m. dilatata hinc interdum sublobata seu lineari-lanceolatis; calycis labio superiore brevi mucronulato; seminibus lævibus nitidis. — Mountain-sides near the copper mines, New Mexico, and in Guadalupe Pass; Oct. (950.) — Leaflets 2 or 3 inches long, mostly 2 or 3 lines wide at the base, thence tapering to an acute point. Cultivated specimens, however, show broader leaflets, more or less dilated or obsoletely sublobed, or gibbous at the base, and passing into the type of P. acutifolius.

P. ANGUSTISSIMUS (sp. nov.): perennis, lævigatus; caulibus diffusis seu volubilibus gracillimis; stipulis ovatis minimis; foliolis angustissime linearibus obtusiusculis aveniis pedunculo paucifloro filiformi brevioribus; calyce breviter campanulato. labio superiore latissimo subemarginato dentibus inferioris ovatis obtusis æquilongo; legumine oblongo falcato plano 3–4-spermo; seminibus leviter rugulosis. — Stony hill-sides, at the crossing of the Rio Grande above Doña Ana, New Mexico, July; and between San Pedro and Santa Cruz, Sonora, Sept. (951.) — Stems numerous. from a firm perennial root, slender and very smooth. Leaflets 1½ to 2 inches long, a line or a line and a half wide, thickish, smooth, very minutely puberulent beneath under a lens, longer than the petiole. Peduncle 2–5 inches long, loosely 2–5-flowered. Pedicels longer than the calyx. Flowers 4 lines long; the ample vexillum and wings purple; the spirally coiled keel yellow. Pod 8–10 lines long, 3 lines wide, narrowed towards the base, nearly glabrous; the flat valves thin.

P. WRIGHTII, *Gray, Pl. Wright. p.* 43. Sides of stony hills, at the copper mines. New Mexico; Aug. (952.) — The specimens are much better than those of 1849, and in fine flowering state. It is a perennial, with a lignescent fusiform root, of a foot or so in length, and an inch in diameter. Stems either prostrate or twining. The leaflets vary considerably in shape; the lateral lobes sometimes little shorter than the middle one, and in the larger leaflets themselves inclined to be two-lobed at the apex. The racemes are rather many-flowered, with the bracts inclined to be persistent. The young legumes are destitute of the conspicuous style which tips those of the former, chiefly fruiting specimens. The character of the species therefore needs some modification.

P. MACROPOIDES (sp. nov. § Microcochle): radice tuberosa; caulibus decumbentibus retrorsum hirsutis; stipulis ovatis acuminatis nervosis; foliolis ovalibus vel subrhombeis integris aut supra medium subunilobatis fol. infimum obtusis superiorum acutis pilis appressis utrinque hirto-pubescentibus; pedunculis folio pluries longioribus puberulis plurifloris; calycibus subsessilibus villosulis, laciniis conformibus lanceolato-subulatis; alis corollæ rotundatis vexillo duplo majoribus; legumine deflexo lineari-falcato puberulo subcompresso 4–6-spermo. — Stony hills at the copper mines, New Mexico; Aug. (953.) — Stems beginning to flower when only 2 inches long, extending a foot or two in length, decumbent or diffusely spreading, flexuose, thickly villous-hirsute; the pubescence of the petioles similar, but not reversed. Stipules 2 or 3 lines long, rather scarious. Petioles 12–18 lines long. Stipels subulate, longer than the petiolules. Leaflets 9–18 lines in length, mucro-

nate, sometimes obscurely angled on one side nearer the summit than the base, sometimes with the angle produced into a broad tooth or lobe of 2 or 3 lines in length. Peduncles 4 to 9 inches long, minutely and retrorsely pubescent, floriferous above the middle. Bracts minute, subulate, caducous. Calyx 2 lines long, equally 5-cleft, or more deeply so between the upper lobes, the narrow and very acute lobes longer than the tube. Vexillum and wings purple in the dried specimens, rotund; the former emarginate, 3 or 4 lines, the latter 6 lines long. Carina yellowish, shorter than the vexillum, strongly circinate-incurved, as in P. heterophyllus. Ovary minutely pubescent, 6-ovuled. Legume 8 or 9 lines long, 2 lines wide, torulose, incurved. Seeds reniform, smooth. — This species is evidently allied to P. macropus, *Benth.* (which I have not seen), the fruit of which is unknown. It appears to differ in the shape of the leaflets, as well as in their pubescence, which is nearly similar on both surfaces, in the hirsute stems, and in the shape and pubescence of the calyx. It should likewise be compared with P. parviflorus, *Schlecht.*

P. ROTUNDIFOLIUS (sp. nov. § Microcochle): perennis, radice tuberosa? caulibus decumbentibus cum pedunculis plurifloris folio ter longioribus retrorsum villosis; stipulis ovatis nervosis; foliolis rotundatis integris utrinque appresso-pubescentibus; calycibus brevissime pedicellatis villosis, laciniis conformibus subulatis; vexillo alis orbiculatis subæquali; legumine deflexo lineari-falcato subcompresso 4 – 6-spermo villosissimo. — Valley west of the Chiricahui Mountains, Sonora, in sandy soil; Sept. (954.) — Closely related to the preceding species; but the peduncles are hairy like the diffuse and slender stems; the leaflets are orbicular or rounded-obovate, often retuse (8 to 12 lines in diameter); the flowers perhaps rather smaller; the calyx more hairy; the wings not so large in proportion to the deeply emarginate vexillum, and the ovary and pod very villous. The blossoms have dried of a purple color; but according to Mr. Wright's memorandum, they are "deep red."

RHYNCHOSIA TEXANA, *Torr. & Gray*, & var. ANGUSTIFOLIA, *Gray, Pl. Wright. p.* 44. Prairies of Turkey Creek, Western Texas, and on the Limpio; May, June. (955.)

GALACTIA TEPHRODES (sp. nov.): subvolubilis; caulibus foliisque pube minuta appressissima sericeo-canescentibus; foliolis 3 oblongo-linearibus utrinque obtusissimis mucronulatis; pedunculis plurifloris; calycis lobis oblongis obtusis, postico integro; legumine recto canescente. — Mountain-sides, near Conde's Camp, between the copper mines and Chiricahui Mountains, New Mexico; Aug. (956.) — Stems numerous from a lignescent root, 2 or 3 feet long, whitened or cinereous with the very fine and close pubescence. Leaflets less canescent above than beneath, 10 to 16 lines long, those of the lower leaves narrowly oblong, of the upper linear, not narrowed at the base, often slightly retuse at both ends; the terminal one rather remote from the others. Lower peduncles longer, the upper shorter, than the leaves. Calyx minutely cinereous-pubescent, nearly 3 lines long. Pod 10 to 14 lines long, 2 lines wide, 4 – 7-seeded. — The pubescence is nearly as in G. heterophylla, *Gray, Pl. Lindh.*

COLOGANIA PULCHELLA, *H. B. K. Nov. Gen. & Sp.* 6. *p.* 413; *Gray, Pl. Wright. p.* 44. Mountain-sides, from Smith's Run to Providence Creek, between the Limpio

and the Rio Grande; June. (957.) — The leaflets are pale and cinereous (not bright green) above as well as beneath, otherwise the specimens accord pretty well with Kunth's description of C. pulchella, of which it is probably only a variety.

C. ANGUSTIFOLIA, *H. B. K. l. c.*; *Gray, l. c.* (cum char.). Rocky sides of mountains, at the head of the Limpio; June, in flower and fruit. (958.) — Except that the flowers are not so large, our specimens admirably agree with Kunth's description, especially in the particulars in which they differ from the narrow-leaved species described below. The linear and *falcate* legumes (which were before unknown in the genus) I have already described. Plants raised from seeds taken from these specimens have the earlier leaves broadly oval (7 or 8 lines long); the succeeding ones oblong, and finally linear.

C. LONGIFOLIA (sp. nov.): volubilis; foliolis ternis nunc 4–5-nis linearibus elongatis acutis vel obtusis longe mucronatis supra glaberrimis subtus reticulatis cum caulibus calycibusque (pedicello longioribus) pilis brevissimis appressis strigulosis; legumine lineari subcompresso recto. — Variat, *α.* foliolis rigidiusculis $1\frac{1}{2}$–3 unc. longis 2–3 lin. latis. *β.* foliolis membranaceis glabellis sæpius lato-linearibus 3 unc. longis 5–8 lin. latis, costa in mucronem sesquilineam longum producta. *δ.* caule simplici suberecto $\frac{1}{2}$-sesquipedali; foliolis angustissime linearibus 3–4 unc. longis 2 lin. latis. — Hills near the copper mines, New Mexico, climbing on low bushes; Aug.? (*α.* 959. *β.* 960.) *δ.* Mountain ravines, on the Sonoita, near Deserted Rancho. Sonora; Sept., in fruit. (961.) — The leaves in all the forms are some of them often 4–5-foliolate, the additional leaflets being inserted with the lateral pair, which are separated from the terminal one by a rhachis of 2 or 3 lines in length. The minute, strigose pubescence of the stem is retrorse. Stipules lanceolate-subulate, strigulose, very small. Pedicels 2 or 3 lines long, shorter than the calyx; which in *α.* and *β.* is 5 or 6 lines long, its upper lobe entire. Corolla violet-purple in the dried specimens. Legume about 2 inches long, 2 lines wide, straight, less compressed than in C. angustifolia, cinereous with the same fine pubescence as the calyx, 10–14-seeded. Seeds subrotund, with a small hilum, not strophiolate. The root is said to be thickened or somewhat tuberous, and to penetrate very deeply. — In the glabrous upper surface of the leaves, and in the fine and close pubescence of the calyx, this plant agrees with the character of C. intermedia, *H. B. K.*, with which it should be compared, notwithstanding the size and shape of the leaflets, which in C. intermedia are said to be only from 9 to 14 lines long. The straight pod, and the characters furnished by the pubescence, sufficiently distinguish it from C. angustifolia.

PETERIA SCOPARIA, *Gray, Pl. Wright. p.* 50. Stony hills near Smith's Run and Eagle Springs, between the Limpio and the Rio Grande; June. Also between Frontera and the Mimbres, New Mexico; July. (962.) — A well-marked, new genus. The flowers are tinged with purple.

CRACCA EDWARDSII (sp. nov.): molliter sericeo-pubescens; caulibus herbaceis e basi suffrutescente; stipulis setaceis; foliolis 4–8-jugis membranaceis ellipticis mucronatis reticulato-venosis concoloribus; racemis laxifloris; bracteis setaceo-subulatis persistentibus; vexillo purpureo; carina flavida; legumine elongato 13–

19-spermo inter semina interstincto. — (Near Monterey, Mexico, *Dr. Edwards*, in herb. Torr.) Valleys in the mountains between the San Pedro and the Sonoita, Sonora (in flower and with young fruit); and on hills between the Barbocomori and Santa Cruz (with ripe pods); Sept. (963.) — Plant a foot high. Lobes of the calyx elongated-subulate, a little shorter than the corolla. Legumes 2 to 2½ inches long, a line and a half wide, straight or nearly so, perfectly glabrous in the specimens from the first-named locality; but minutely pubescent in the others. The latter likewise have smaller leaflets (only half an inch in length) with a shorter mucro, and the soft silky pubescence deciduous, except that of the margins and midrib. — The genus is a yet unpublished one of Mr. Bentham, equivalent to Tephrosia § Craccoides of De Candolle, including also T. Caribæa, &c.; but is nearer Coursetia than Tephrosia.

Tephrosia leucantha, *H. B. K. Nov. Gen. & Sp.* 6. *p.* 460. *t.* 577? Hill-sides between Barbocomori and Santa Cruz, Sonora; Sept. (964.) — The stems are one or two feet high, from a thickened root, terminated by a single short raceme, which bears ripe pods only. The foliage, calyx, &c. accord very well with Kunth's figure. The legumes are widely spreading, 1½ to 2 inches long, 2 lines wide, linear, straight or nearly so, pointed, thickly clothed with a yellowish villous tomentum. Seeds 8 – 10. The flowers not seen.

T. leiocarpa (sp. nov.): caule erecto subsimplici petiolis calycibusque pube minuta appressa cinereis; stipulis setaceis; foliolis 8 – 10-jugis cum impari lineari-oblongis obtusis mucronatis supra glabris subtus sericeis juventute canescentibus; pedunculis terminalibus et in axillis summis brevibus plurifloris; calycis lobis triangulari-subulatis tubo longioribus; legumine recto 10 – 14-spermo glaberrimo. — On the Sonoita, near Deserted Rancho, Sonora; Sept. (965.) — Stems a foot or more in height, rather slender, very numerous from a thick and lignescent root. Leaflets 9 to 14 lines long, 3 lines wide, often a little narrowed towards the base, thickish. Peduncle, with the rhachis, 2 to 4 inches long. Flowers not seen. Unripe pods linear, about 2 inches long, 3 lines wide, flat, very smooth, not stipitate.

T. tenella (sp. nov.): annua, glabella; caule ramoso spithamæo; stipulis setaceis; foliolis 1 – 3-jugis cum impari linearibus obtusis membranaceis subtus (sub lente) parce striguloso-puberulis; racemis oppositifoliis paucifloris; pedicellis plerisque geminis paribus remotis, infimis ad basim pedunculo folio bracteatis; laciniis calycis subulatis, posticis ad medium coalitis; staminibus diadelphis; legumine rectiusculo glabello. — Pebbly beds of mountain torrents, near the San Pedro, Sonora; Sept. (966.) — Stems slender, branched from the base, erect or diffuse. Leaflets mostly 3 or 5, an inch long, 1½ to 3 lines wide, mucronate, thin, green both sides, the straight veins not conspicuous underneath. Peduncle 3 – 5 inches long, with an internode of one to three inches between the lowest pair of pedicels (which are as if axillary) and the next pair. Bracts minute. Flowers 3 lines long, simple. Legume spreading, 12 to 16 lines long, 2 lines wide, 6 – 7-seeded.

Glycirrhiza lepidota, *Nutt.; Gray, Pl. Wright. p.* 50. G. glutinosa, *Nutt.* Along the Rio Grande above and below El Paso. Also on the Mimbres; July, Aug. (967.)

INDIGOFERA SPHÆROCARPA (sp. nov.): frutescens, glabella; caulibus erectis foliosissimis; foliis pinnatis; petioli brevi; foliolis 7–8-jugis cum impari lineari-oblongis basi attenuatis apice obtusis retusisve supra glabris; racemis multifloris; leguminibus ovato-globosis monospermis. — Bed of a mountain torrent, near Santa Cruz, Sonora; Sept. (968.) — "Stems numerous from the root, 2–4 feet high." Leaflets 5 or 6 lines long, 2 lines wide, very glabrous above, minutely and sparsely strigulose and cinereous underneath. Stipules none, or a mere gland. Flowers not seen; the specimens being entirely in fruit. Fruiting racemes 4 or 5 inches long, bearing a great number of globular and nearly glabrous legumes, which are only a line and a half long, on pedicels of nearly the same length, tardily if at all dehiscent. Seed entirely solitary, globose.

I. LEPTOSEPALA, *Nutt.*; var. cinereo-argentata. Pebbly bed of a tributary of the Pecos; June.

PRORALEA CUSPIDATA, *Pursh. Fl.* 2. *p.* 741. Rocky hills of the San Pedro, Western Texas; May.

P. ESCULENTA, *Pursh.* Stony hills of the San Felipe, Western Texas; June.

P. FLORIBUNDA, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 300. Sides of mountains at the copper mines, New Mexico; Oct. (969.)

EYSENHARDTIA AMORPHOIDES, *H. B. K.*? var. ORTHOCARPA: leguminibus rectis 6–7 lin. longis pendulis; foliolis majoribus 6–8 lin. longis crebre glanduloso-punctatis. — Mountains at Guadalupe Pass, between San Bernardino, Sonora, and the copper mines, Sept.; in fruit. (980.) — The leaflets are still larger than those of Wright's No. 116, of which the fruit is not known. The legumes are nearly twice as large as those of Lindheimer's No. 374 and Coulter's and Gregg's Mexican specimens, in which they are ascending on the rhachis and falcate-incurved; in the present plant they are linear, straight, and all deflexed. If further specimens do not tend to unite them, the present plant must be distinguished specifically. But Schauer describes the fruit of his Mexican specimens in Aschenborn's collection as lanceolate, a little arcuate at the apex, 7 lines long and 2 lines wide.

DALEA LANATA, *Spreng.*; *Gray, Pl. Wright. p.* 47. Sandy soil, on the Rio Grande; very common; July. (981.)

D. LACHNOSTACHYS, *Gray, Pl. Wright. p.* 46. Hill-sides, between the Barbocomori and Santa Cruz, Sonora; Sept. (982.) — Root tapering, apparently perennial. Stems 6 to 12 inches high, with spreading branches.

D. NANA, *Torr. in Pl. Fendl. p.* 31. Hills on the Pecos; June. (1351.)

D. POGONATHERA, *Gray, Pl. Fendl. p.* 31, *& Pl. Wright. p.* 48. Stony hills near El Paso, May; and at Comanche Spring, Texas, June. (1352.)

D. LASIATHERA, *Gray, Pl. Wright. p.* 48. Stony prairies, Western Texas; May. Valley of the Limpio; June. (983.)

D. FRUTESCENS; var. spicis pl. m. elongatis densifloris, *Gray, l. c. p.* 46. Rocky hills on the Pecos; June. — Also with short and dense spikes, on Live Oak Creek. (1353.)

D. FORMOSA, *Torr.*; *Gray, l. c.* Stony prairies on San Felipe Creek; May. Sandy hills on the Rio Grande, New Mexico; March, Oct. (984.)

D. ALOPECUROIDES, *Linn.*; *Gray*, *l. c.* Hill-sides at the copper mines, New Mexico; and on the borders of Sonora. (985.)

D. WISLIZENI, *Gray*, *Pl. Fendl. p.* 32; var. foliolis minus sericeis obtusis supra glabellis subtus tantum cinereo-pilosis (caulibus frutescentibus e basi ramosis). — Mountain ravines near Santa Cruz, Sonora, Sept. (986.) — Except in the points mentioned, the specimens accord with D. Wislizeni. They have the same gland-like setulæ on the calyx-lobes, and the solitary gland near the tip of the petals, the wings excepted. The corolla is bright rose-purple in the specimens. The stems are woody towards the base, erect or ascending, 2 or 3 feet high. Stipules subulate.

D. ARGYRÆA, *Gray*, *Pl. Wright. p.* 47. On the San Pedro or Devil's River, Western Texas; July.

D. SCOPARIA, *Gray*, *Pl. Fendl. p.* 32, & *Pl. Wright. p.* 47. Sand-hills near San Elizario, New Mexico; June. (1354.)

D. ALBIFLORA (sp. nov.): cinereo-pubescens; caulibus erectis e radice perenni vix glandulosis; foliis juventis sericeo-canescentibus; foliolis 10 – 15-jugis cum impari oblongis obtusis supra glabellis subtus parce glanduloso-punctatis; petiolo communi brevissimo; stipulis minimis subulatis; spicis cylindricis densis; calycibus cum bracteis subulatis æquilongis albo-villosis, dentibus subulatis tubo paullo brevioribus; petalis albis æquilongis subconformibus. — Hill-sides on the San Pedro and Barbocomori, Sonora; Sept. (987.) — Stems one or two feet high, simple, or sparingly branched above. Leaves 1 – 2 inches long. Leaflets crowded, 2 or 3 lines long, more or less pubescent beneath with very fine silky hairs. Spikes silvery-canescent before the flowers expand, one or two inches long, very dense. Bracts caducous. Flowers 3 lines long; the lamina of the pure white petals a line and a half long, of the vexillum round-oval, of the other petals oval-oblong. Anthers yellow, tipped with a gland. Ovary and base of the style villous. — The plant has somewhat the general aspect of D. alopecuroides or of Petalostemon phleoides.

D. ALBIFLORA; var. humilis; foliolis spicisque angustioribus. — On mountains near Santa Cruz; Sept. (988.)

D. LÆVIGATA (sp. nov.): caulibus e radice crassa perenni pluribus erectis striatis foliisque glaberrimis lævibus; foliolis 17 – 20-jugis cum impari lineari-oblongis subacutis canaliculatis (sesquilineam longis) subtus parce punctatis; spicis cylindraceis densis; bracteis ovatis acuminatissimis parce glandulosis margine præsertim arachnoideo-villosis florem subæquantibus; calyce villosissimo, dentibus triangulari-subulatis tubo brevioribus; petalis pallide flavis subæquilongis. — On the Chiricahui Mountains, and on the Barbocomori, Sonora; Aug., Sept. (989.) — Stems about 2 feet high from a lignescent root, rather strict and slender, more or less branched above, sharply striate-angled, perfectly glabrous and smooth, leafy; the branches sparingly if at all punctate. Stipules minute, subulate. Leaves 1 to 2 inches long, pale green. Leaflets thickish, veinless except the obscure midrib, perfectly glabrous as well as the rhachis, and sparingly punctate underneath. Spikes about an inch long and a quarter of an inch thick, silky-villous. Bracts deciduous only with the fruiting calyx, greenish, 2 lines long. Corolla small; the lamina of the petals a line and a half long; vexillum orbicular; the others oblong. Ovary and base of the style silky-villous.

D. BRACHYSTACHYS (sp. nov.): annua, humilis; caulibus e basi ramosis diffusis foliisque glaberrimis; foliolis 5–11 cuneato-oblongis vel sublinearibus emarginatis subtus rhachique grosse glandulosis; spicis breviter pedunculatis globosis demum oblongis densifloris; bracteis ovatis acuminatis concavis grosse glandulosis margine haud scarioso villoso-ciliatis calyce paullo brevioribus subpersistentibus; calyce sericeo-villosissimo, dentibus setaceo-subulatis tubo sublongioribus corolla flava paullo brevioribus; petalis inæqualibus. — Valleys, in alluvial soil, between the San Pedro and the Sonoita, Sonora; Sept. (990.) — Stems a span high, ascending, slender, sparingly glandular-punctate. Stipules subulate, minute, rather persistent. Leaflets 4 to 6 lines long, much like those of D. pogonathera and D. lasiathera. Spikes 3 lines in diameter, in fruit only twice that length, very densely flowered. Bracts greenish, less boat-shaped than those of the above-mentioned species, and the margins not scarious, but more or less villous-ciliate, otherwise glabrous, or the upper ones villous next the base. Calyx 2 lines long; the teeth very plumose-villous, equalling the small vexillum and the wings. Keel-petals more than twice the size of the others, $2\frac{1}{2}$ lines long, including the claws. Ovary villous with white hairs like those of the calyx.

D. POLYGONOIDES (sp. nov.): annua, humilis; caule ramosissimo gracili foliisque glaberrimis; foliolis 3–9 lato-linearibus emarginatis basi acutis glaucescentibus rariter glanduloso-punctatis; pedunculis gracilibus; spicis oblongis vel cylindricis densifloris; bracteis ovatis seu obovatis acuminatissimis membranaceis grosse-glandulosis villoso-ciliatis calycem æquantibus persistentibus; calyce sericeo-villosissimo, dentibus subulato-setaceis tubo æquilongis; petalis subæquilongis albidis. — Pebbly bed of mountain torrents, near the copper mines, New Mexico; Oct., in fruit. (991.) — Stems a span high, much branched; the branches divergent, slender, sparingly glandular-dotted. Stipules subulate, minute, deciduous. Petiole with the rhachis half an inch long. Leaflets 4 to 6 lines long, a line and a half wide, veinless, apparently a little succulent, livid, the upper surface often purplish; the glands few and rather small. Spikes half an inch to an inch long, 2 to 3 lines thick, dense, livid. Bracts a line and a half long, dotted with a few large glands, wholly persistent, even after the fruited calyces have fallen, glabrous, except the villous margins and sometimes the base; the lowest broadly ovate, the upper obovate and tapering to the base. The specimens are nearly all in fruit; the flowers found at the apex of the spikes bear petals, which are only a line in length, and white or whitish. Legume villous.

D. FILIFORMIS (sp. nov.): annua; caule exili erecto laxe ramoso foliisque glaberrimis; foliolis 3 digitatis (raro 5 pinnatis) filiformibus parce punctatis; pedunculis filiformibus; spicis capitatis demum cylindraceis densifloris; bracteis ovatis acutis carinatis ciliatis vix glandulosis calyce brevioribus caducis; dentibus calycis sericeo-villosissimi subulatis tubo æqualibus; petalis subæquilongis (purpureis vel roseis). — Hill-sides near the copper mines, New Mexico; Aug., in flower; Oct., in fruit. (992.) — The most slender of all the species known to me; the stems from 4 to 10 inches high, at length copiously and paniculately branched; the filiform branches spreading. Stipules minute, setaceous. Leaflets 6 to 12 lines long, usually longer

but scarcely thicker than the petiole, channelled on the upper side; when three, manifestly digitate; when five, the additional pair inserted one or two lines lower down. Peduncles one or two inches long. Spike silky-villous, 2 or 3 lines in diameter in flower; in fruit becoming half an inch long. Calyx a line and a half long. Lamina of the petals half a line long; vexillum round-cordate; the wings very oblique, nearly the length of the keel. Ovary villous. — Cultivated, from seeds communicated by Mr. Wright, in the Cambridge Botanic Garden, the much-branched stems attain a foot or more in height.

D. Wrightii, *Gray, Pl. Wright. p.* 49. Stony hills near El Paso; May. (1355.) — "Flowers yellow, turning purplish."

D. Jamesii, *Torr. & Gray, Fl.* 1. *p.* 308; *Gray, Pl. Wright. p.* 49. Stony hills on the Pecos and the Limpio; June. (993.)

D. calycosa (sp. nov.): suffruticulosa, cinereo-puberula; caulibus ramosissimis decumbentibus; foliolis 7 – 14-jugis cum impari obovatis ovalibusve retusis juxta incisuram unipunctatis supra glabris subtus nunc glabratis; spicis breviter pedunculatis oblongis modice densifloris; floribus post anthesin recurvis; bracteis lanceolatis calyce brevioribus caducis; dentibus calycis obliqui villosi lato-lanceolatis tubo duplo longioribus; petalis albo-purpureis, vexillo reniformi alisque carina dimidio brevioribus. — Hills near the Deserted Rancho, on the San Pedro, Sonora; Sept. (994.) — Stems a span long, slender, from a suffrutescent base. Stipules subulate. Leaflets 2 or 3 lines long, minutely and often sparsely strigose-pubescent underneath. Spikes 1 to 2 inches long, with the flowers contiguous but not compact. Calyx campanulate, oblique, 3 lines long, sparsely villous; the short tube glandular-dotted between the ribs; the lobes remarkably long and large for the genus, greenish, about the length of the vexillum and oblique wings. Keel (2 – 3 lines long) and wings apparently white marked with rose-purple, the vexillum bright purple. Legume orbicular, flat, apparently 2-valved, one-seeded. Ovules 2.*

* The species of Dalea described or enumerated in this and the former memoir, and in *Plantæ Fendlerianæ* and *Plantæ Lindheimerianæ*, are so numerous as to render an artificial conspectus convenient. The species may be disposed as follows: —

* *Calyx profunde quinquefidus; lobis lato-lanceolatis subfoliaceis.* — D. calycosa.

* * *Calyx villosissimus, dentibus setaceis vel subulatis.*

+ Fruticosæ, glabræ, multijugatæ; spicis paucifloris. — D. formosa.

+ + Herbaceæ, glabræ; foliis 5 – 6-jugis; spicis multifloris.

Perennes. Bracteæ cymbæformes, scarioso-marginatæ, glaberrimæ, persistentes.

Spica laxiflora, plumosa. Corolla flava. Stamina 9. — D. laxiflora.

Spica densiflora. Corolla purpurea.

Calycis dentes setacei, plumosissimi, tubo longiores. — D. pogonathera.

Calycis dentes subulati, villosissimi, tubo breviores. — D. lasiathera.

Annui. Bracteæ villoso-ciliatæ, immarginatæ.

Bracteæ subpersistentes: spica globosa vel oblonga: corolla flava. — D. brachystachys.

Bracteæ persistentes: spica cylindrica: corolla albida. — D. polygonoides.

Bracteæ caducæ: foliola filiformia: corolla purpurea. — D. filiformis.

Petalostemon exile (sp. nov.): annum, glabrum; caule erecto tenui simplici vel simpliciter ramoso; foliolis 3 raro 5 linearibus mucronato-apiculatis parce punctatis, impari lateralibus longiore; spica longe pedunculata cylindrica densa; bracteis ovatis subulato-acuminatis subvillosis floribus paullo brevioribus persistentibus; calyce villosissimo, dentibus setaceo-subulatis tubo æquilongis petala rosea subæquantibus. — Hill-sides, near Santa Cruz, Sonora, Sept.; also near the copper mines, New Mexico, Oct. (995.) — Stems 6 to 14 inches high, very slender. Lateral leaflets 4 to 6 lines, the terminal one 9 – 18 lines in length, a line or less in width, plane, glabrous, or with a few minute hairs. Spike an inch or an inch and a half long in fruit, 3 lines thick; the lowest bracts broader and less subulate-pointed than the upper, and nearly glabrous; the others are arachnoid-villous, especially the margins. Calyx 2 lines long. Petals very small, oval, nearly similar. Stamens 5. — The genus Dalea scarcely occurs east of the Mississippi; and even in Arkansas and Eastern Texas there are ten Petalostemons to five Daleas. But as we proceed westward and southward, the former genus disappears, and the species of the latter largely increase. Petalostemon violaceum, the most widely diffused species, alone reaches the northern frontiers of New Mexico; the present species comes from farther south, and is the only one known to occur in Mexico.

Melilotus parviflora, *Desf.* Near El Paso, and in Sonora; naturalized. (996.)

Medicago sativa, *Linn.* Fields, El Paso and San Elisario; introduced. (1356.)

Trifolium involucratum, *Willd.; Benth. Pl. Hartw. no.* 54; *Gray, Pl. Fendl. p.* 33. Valley of the Sierra de los Animos, New Mexico, on the borders of springs; Oct. (997.) — The margin of the leaflets is fringed with as long setaceous teeth as in any form of T. fimbriatum, *Lindl.*; but the calyx-teeth are much longer than the tube.

\+ \+ \+ Herbaceæ, glabræ; foliis multijugis; spicis elongatis alopecuroideis.
- Perennis, microphylla: corolla flava. — D. lævigata.
- Annua: corolla alba roseo tincta. — D. alopecuroides.

\+ \+ \+ \+ Herbaceæ vel suffruticosæ, pubescentes, tomentosæ, vel sericeæ.
- Spica densissima, recta; floribus albis. — D. albiflora.
- Spica densissima, crassa, villosissima; floribus flavis vel purpureis.
  - Foliola appresso-sericea, 2 – 4-juga, raro pinnato-trifoliolata.
    - Spica longissime pedunculata, e caule virgato erecto. — D. aurea.
    - Spica breviter pedunculata: caules ramosi: foliola oblonga obtusa. — D. nana.
    - Spica sessilis: foliola lanceolata acuta. — D. Wrightii.
  - Foliola appresso-sericea, tria, digitata! — D. Jamesii.
  - Foliola laxe villosa, 4 – 8-juga.
    - Glanduloso-tuberculata: spica crassa, bracteis pubescentibus. — D. lachnostachys.
    - Villoso-canescens, humilis; bracteis villosissimis. — D. mollis.
- Spica laxiuscula; corolla pulchre purpurea.
  - Tomentosa; caulibus diffusis ramosissimis. — D. lanata.
  - Sericea; caulibus strictis simpliciusculis. — D. Wislizeni.

* * * *Calyx pubescens vel canescens, dentibus brevibus.* (*Frutescentes.*)
- Foliola 7 – 13, sericeo-argentea: corolla flavo-purpurea. — D. argyræa.
- Foliola 5 – 7, glabella: corolla alba. — D. leucostachys.
- Foliola 1 – 3, linearia: corolla pulchre violacea. — D. scoparia.

* * * * *Calyx nisi ad margines glaber; dentibus brevibus.* — D. frutescens.

Hosackia Purshiana, *Benth.; Torr. & Gray, Fl.* 1. *p.* 327. Valley of Sonoita Creek, Sonora; Sept. (998.)

H. puberula, *Benth. Pl. Hartw. p.* 305; *Gray, Pl. Wright. p.* 50. Hills near the San Pedro, Sonora; Sept. Also on Rock Creek, towards the head of the Limpio; June. (999.)

H. puberula; var. nana, diffusa, magis cinerea; foliolis brevioribus et latioribus. — Organ Mountains, northeast of El Paso, April; in flower and fruit. (1357.)

H. Wrightii (sp. nov.): sericeo-pubescens; caulibus e radice perenni erectis rigidis ramosissimis; stipulis nigris glandulæformibus; petiolo vix ullo; foliolis 3 – 5 linearibus imisve oblongis; pedunculis unifloris folio brevioribus, superioribus brevissimis; bractea unifoliolata lineari; calycis dentibus setaceo-subulatis tubo oblongo-campanulato æquilongis corolla (flava purpureo tincta) multo brevioribus. — Stony hills at the copper mines, New Mexico, Aug. (1000.) — Plant about a foot high, herbaceous; the young branches and foliage silvery-pubescent, when old glabrate. Petioles of the lower leaves barely half a line long; the upper almost none. Leaflets 5 to 7 lines long, half a line wide, or towards the base of the stem a line and a half wide. Lower peduncles 6 to 8 lines long, the upper one to three lines long, rarely 2-flowered. Calyx minutely silky-pubescent, the tube 2 to $2\frac{1}{2}$ lines long. Corolla 6 lines long, not counting the included claws. Legume over an inch long, straight, acute, clothed with the same pubescence as the calyx. — Allied to the preceding species; from which it is distinguished by its more upright and bushy growth, its nearly sessile leaflets, short peduncles, and larger flowers. From H. rigida, *Benth.*, its narrow leaflets, shorter calyx-tube with longer teeth, and short peduncles seem abundantly to distinguish it.

Astragalus mollissimus, *Torr.; Gray, Pl. Wright. p.* 53. Prairies of Escondido Creek, between the Pecos and the Limpio; June, in fruit.

A. Bigelovii (sp. nov.): multiceps, acaulescens, undique sericeo-villosissimus; stipulis triangulari-subulatis basi petioli adnatis; foliolis 9 – 12-jugis ovalibus seu obovato-oblongis; pedunculis scapiformibus folia superantibus, fructiferis recurvis vel humifusis; spica cylindrica confertiflora; tubo calycis villosissimi cylindrico dentibus subulatis triplo longiore; corolla purpurea; leguminibus ovatis apiculato-acuminatis incurvis lanosissimis complete bilocularibus suturis parum sulcatis, loculis polyspermis. — On the Organ Mountains northeast of El Paso; April 30th; chiefly in fruit. (1358.) — Plant a span or more in height from a perennial lignescent root; the leaves, scapes, &c. thickly clothed with a canescent wool, which is rather villous than silky. Leaflets 5 to 8 lines in length. Spike 3 or 4 inches long, many-flowered, compact. Flowers nearly sessile, 7 – 8 lines long. Legumes half an inch long, very densely woolly, as well as the scariously marcescent calyx, coriaceous, the cross-section orbicular. — Manifestly allied to A. mollissimus, and with the same habit; but more strictly acaulescent, more villous, and especially distinguished by its turgid and very woolly (instead of glabrous) pods, the sutures not introflexed. I dedicate it to Dr. J. M. Bigelow, the physician of the Boundary Commission, to whom, with Mr. Wright, we are indebted for the discovery of this striking species.

A. Nuttallianus, *DC.*; var. pube strigulosa subcanescens; leguminibus arcuatis nunc striguloso-hispidulis (ut in var. trichocarpo) nunc cum ovario glabris. — Stony hills near El Paso; March, April. (1359.) — Plant about as large as Texan and Arkansan specimens, but much more strigose-cinereous.

A. Nuttallianus, var. pumilus, etc. (*Gray, Pl. Wright. p.* 52); 2 – 3-pollicaris, cæt. ut in præcedente; leguminibus sæpe cinereo-hispidulis. — Dry hills on the Rio Blanco, Piedra Pinta, and Pecos. Also at El Paso, and on Lake Gusman, Chihuahua; April, May. (1001.) Some specimens with shorter pods pass into the next.

A. Nuttallianus? var. pumilus, strigoso-canescens; caulibus diffusis; leguminibus brevioribus. — Near Lake Santa Maria, Chihuahua; April. (1360.)*

A. vaccarum (sp. nov.): perennis, strigoso-puberulus; caulibus adscendentibus gracilibus; stipulis lanceolatis basi imo petiolo adnatis; foliolis 5 – 8-jugis subsparsis lato-linearibus obtusis mucronulatis supra glabris; pedunculis folio longioribus; racemis multifloris densis; floribus brevissime pedicellatis mox deflexis; calycis dentibus subulatis tubo campanulato subæquilongis; corolla incurva ochroleuca; leguminibus haud stipitatis lineari-oblongis arcuatis puberulis dorso latosulcatis (sectione transversali obcordata) bilocularibus oligospermis. — Ojo de Vaca, west of the copper mines, New Mexico; Aug. (1002.) — Stems 1 or 2 feet high, branched from the base, weak. Leaflets 6 – 8 lines long, a line and a half or less in width, the pairs rather distant. Peduncles 3 – 5, the spicate raceme one to two, inches in length. Bracts subulate, persistent, as long as the calyx. Flowers only 2 lines long, smaller than those of A. gracilis, *Nutt.*, and the corolla more incurved. Legume 4 lines long, a line in diameter; the cells 3 – 5-seeded. — This species resembles A. Hartwegi, *Benth.*, more than any other known to me; but the incurved flowers are only half as large, the stipules and leaflets are narrower, the latter fewer, the racemes much shorter, &c.

A. humistratus (sp. nov.): subsericeus; caulibus e basi suffrutescente ramosissimis prostratis foliosis; stipulis inter se coalitis oppositifoliis; petiolo brevissimo; foliolis 7 – 9-jugis lineari-oblongis acutis supra glabratis subtus pilis laxe appressis hirsuto-sericeis; pedunculis folium æquantibus; racemo cylindraceo subdensifloro;

* The following species was found near the copper mines by Dr. Bigelow, early in the season. It is allied to Astragalus leptopus, *Benth. ined.*, in Coulter's Mexican collection; but has fewer and retuse leaflets, smaller flowers, and smaller pods, which are obtuse at each end and not stipitate.

Astragalus Cobrensis (sp. nov.): striguloso-puberulus; caule humili gracili; stipulis triangulatis a petiolo modice elongato liberis; foliolis 7 – 10-jugis obovatis oblongisve retusis supra glabris; pedunculo folium superante plurifloro; calyce pedicello paullo longiore, dentibus subulatis tubo æquilongis; leguminibus haud stipitatis oblongis utrinque obtusis obcompressis glabellis dorso late concavis bilocularibus polyspermis, sutura ventrali extus prominente. — Near the *Cobre* or copper mines (Santa Rita del Cobre), New Mexico; April or May. — Stems slender, a span high; the root wanting in the specimen. Petioles half an inch or more in length to the lowest pinnæ. Leaflets 3 lines long, rather fleshy, strigulose-pubescent when young, the upper surface early glabrate and the lower at length nearly so. Racemes loose, 10 – 15-flowered; the flowers spreading, barely 3 lines long. Bracts shorter than the pedicels. Calyx pubescent with dark hairs. Corolla purple. Legumes pendulous, half an inch long, 2 to 2½ lines wide (contrary to the partition); the ventral suture salient; the dorsal face broadly concave; the partition extending quite to the ventral suture, but not coherent with it.

calycis villosi dentibus lineari-subulatis tubo campanulato æquilongis; corollæ violaceæ carina apice angustata producta; leguminibus lineari-oblongis arcuatis pubentibus sutura dorsali introflexa semibilocularibus polyspermis. — Pebbly bed of a stream, and on hills under pine-trees, near the copper mines, New Mexico; Aug. (1003.) — Root perpendicular, penetrating deeply. Stems a foot or more in length, canescently strigose-hirsute, leafy throughout. Stipules scarious, 3 lines long, hairy, ovate-lanceolate, acuminate; the upper united to the middle, the lower almost to their summits. Leaves $1\frac{1}{2}$ to 2 inches long. Leaflets 5 or 6 lines long, one or two lines wide, linear or oblong, silky-hirsute (like the peduncles, &c.), and when young silky-canescent, especially beneath, with rather long and loosely-appressed straight hairs. Raceme one or two inches long, 12 – 20-flowered; the flowers at first contiguous, but not densely crowded, 4 or 5 lines long, showy. Bracts rather persistent, lanceolate-subulate, villous, as long as the calyx. Calyx-tube a line and a half long. Corolla deep violet in the dried specimens; the keel tapering and somewhat prolonged at the apex, but obtuse. Ovules about 24. Immature legume 8 or 9 lines long, with a broad and shallow dorsal groove. Mature pods not seen.

A. (Phaca) Fendleri: parce striguloso-puberulus; caule adscendente gracili flexuoso e radice perenni; stipulis triangulato-subulatis; foliolis 7 – 11-jugis oblongo-linearibus oblongisve obtusis nunc retusis (6 – 10 lin. longis); racemis longe pedunculatis patentibus 10 – 20-floris laxis folium superantibus; floribus purpureis patulis; calycis nigro-puberuli dentibus subulatis tubo brevioribus; leguminibus oblongis inflatis chartaceis glabellis apiculatis facie ventrali rectiusculis dorsali gibbosis polyspermis. — Phaca Fendleri, *Gray, Pl. Fendl. p.* 36. (1004.) — Pine hills, from the Mimbres to the copper mines, New Mexico; Oct. — The specimens are entirely in ripe fruit, and, except that they are larger, correspond with Fendler's No. 158 (which was likewise gathered in fruit), having shorter and broader, oblong or elliptical, and often emarginate leaflets; but some specimens make a near approach to Fendler's No. 157 (flowering specimens), to which they may be safely united. The ripe pods are from 9 to 12 lines long, and 4 or 5 in diameter. — I defer to Mr. Bentham in uniting Phaca to the vast genus Astragalus.

A. (Phaca) Sonoræ (sp. nov.): argenteo-sericeus, humilis; caulibus decumbentibus gracilibus e radice perenni; stipulis ovatis scariosis, inferioribus inter se folio opposito pl. m. coalitis; foliolis 7 – 8-jugis anguste oblongis lanceolatisve acutatis utrinque sericeis; pedunculis folio mox longioribus; racemo 8 – 12-floro; calycis sericei dentibus setaceis tubo æquilongis; corolla purpurea; leguminibus lunatis turgidis chartaceis puberulis, suturis haud introflexis. — Mountain valleys, between the San Pedro and the Sonoita, Sonora; Sept. (1005.) — Stems a span or more in length, leafy. Leaflets 3 or 4 lines long, canescently silky and silvery beneath, and hardly less so above. Peduncle 2 or 3 inches long. Flowers 4 to 5 lines long, approximate. Bracts a little longer than the very short pedicels. Legumes barely half an inch long, 2 to 3 lines in diameter, falcate-incurved, pointed, turgid, but somewhat compressed, the upper suture acute. Seeds 8 or 10. — This bears some resemblance to A. (Phaca) gracilentus, No. 159 of Fendler's collection: but that is not silky, and has larger and nearly straight pods, smaller and paler flowers, &c.

A. (Phaca) triflorus. Phaca triflora, *DC. Astrag. t.* 1. *& Prodr.* 2. *p.* 273. P. Candolliana, *H. B. K. Nov. Gen. & Sp.* 6. *p.* 495. *t.* 586. Sandy banks of the Rio Grande below El Paso; April, June. (1361.) (Chihuahua, &c., *Gregg.* Mexico, *Coulter.*) — The specimens accord very well with the figures and description of Humboldt's plant, from the volcano of Jorullo, which is in Mexico, not in Peru, as is inadvertently stated by De Candolle. The name is scarcely allowable; since the peduncle is sometimes as much as 15-flowered. But there is a recent Astragalus Candollianus. Phaca annua, *Geyer*, apparently differs from this only in its incurved and sharp-pointed pods. Should they be joined, this later name might be adopted. — There are two forms in the collection of 1852, one dwarf or early, with narrow leaflets, the root plainly annual; the other (also from near Lake Gusman) larger and smoother, with obovate leaflets.

A. (Phaca) tephrodes (sp. nov.): villoso-canescens; caule brevi e radice bienni? stipulis triangulatis scariosis fere liberis; foliolis 7 – 9-jugis oblongis seu ovalibus supra nunc subglabratis; pedunculo plurifloro foliis brevioribus; floribus subsessilibus; calycis tomentosi dentibus subulatis tubo campanulato dimidio brevioribus; "corolla purpurea"; leguminibus oblongis acuto-apiculatis arcuatis turgidis cinereis chartaceis, suturis haud introflexis extus prominulis. — Plains at the base of the Organ Mountains, New Mexico; April. — The single specimen gathered is not in good condition, although it has both flowers and full-grown fruit. The stems are only an inch long; but they doubtless elongate later in the season; they are clothed, like the whole plant, with a cinereous rather hirsute-villous pubescence. Leaves crowded; the leaflets 4 or 5 lines long. Spike an inch long, rather dense. Flowers 4 or 5 lines in length: the corolla pale, but said to be purple in Mr. Wright's notes. Legume half an inch long, not stipitate, the transverse section probably orbicular or nearly so, and 2 lines broad in the living plant.

Oxytropis Lamberti, *Pursh*, var. *Gray, Pl. Wright. p.* 53. Sides of ravines between the Mimbres and the copper mines, New Mexico, Oct.; in flower and fruit. (1006.) — Specimens even larger than Wright's No. 180; the scapes sometimes a foot high; and the leaflets 3 or 4 lines wide.

Chætocalyx Wislizeni (*Gray, Pl. Wright. p.* 51): adde char.: lomento moniliformi, 3 – 4-articulato, articulis oblongis compressis faciebus trinervatis. — Open prairies on branches of the San Pedro, east of Santa Cruz, Sonora, Sept.; in fruit. (1007.) — A few scattered and minute bristles may be seen on the fruiting calyx. Legumes an inch to an inch and a half in length, subsessile in the calyx, more or less contracted at the joints, which break apart at maturity; the articles are 3 or 4, oval or oblong, truncate at the ends, compressed, somewhat margined, one-seeded, 3 – 5 lines long, coriaceous, puberulent, their faces marked with three subparallel nerves, and minutely reticulated between the nerves; the terminal joint wholly, or its sterile apex, somewhat foliaceous and dilated. The cells are lined with woolly hairs. Seeds oblong, compressed. Radicle incurved. — The fruit of the original species of Chætocalyx, *DC.* is still unknown. That of the present plant is truly Hedysareous. It differs from the character of Rhadinocarpus, *Vogel*, (which Mr.

Bentham has suggested to me as probably a Chætocalyx,) chiefly in the distinctly flattened loment.

ZORNIA RETICULATA, *Smith ; DC. Prodr.* 2. *p.* 316. Hills near Santa Cruz, Sonora; Sept. (1008.) — The short aculei of the loment are not smooth, but retrorsely scabrous under a lens.

DESMODIUM GRAMINEUM (sp. nov.): glaberrimum ; caulibus e radice perenni erectis gracillimis ; stipulis minutis subulatis ; foliis omnibus unifoliolatis ; foliolo anguste lineari prælongo subtus nervato-venoso ; racemis paniculatis ; lomento 3 – 4-articulato breviter stipitato, articulis ovalibus. — Crevices of rocks on the Sonoita, near Deserted Rancho, Sonora; Sept. (1009.) — A unifoliolate species of the section Chalarium, remarkable for its long and slender grass-like leaflets. These are from three to five or even six inches long, and from one to two, the very largest three, lines wide, membranaceous in texture, and perfectly glabrous, like the rest of the plant. The slender stems are one or two feet high. Bracts minute. Flowers small. Articles of the loment $1\frac{1}{2}$ to 2 lines long, much deeper separated than in D. linearifolium.

D. ANNUUM (sp. nov.): pilosulum ; caule tenello e radice annua erecto subsimplici ; stipulis stipellisque setaceis cum petiolo longiusculo semper unifoliolato pilosis ; foliolo ovali membranaceo concolore ciliato ; racemis paucifloris ; lomento deflexo vix stipitato, articulis 4 – 5 orbiculatis ciliolatis medio adnexis. — Sonora, with the preceding and the succeeding. (1009ª.) — Stem 4 to 8 inches high, slender, erect or ascending, 8 – 10-leaved. Leaves all unifoliolate, very thin, oval or ovate-oblong, or the uppermost narrowly oblong, obtuse at both ends, not in the least inclined to be cordate ; the larger $1\frac{1}{2}$ inches long and an inch wide ; the earlier ones much smaller ; the primordial ones opposite. Pedicels 3 to 5 lines long. Flower 2 lines long. Loments 6 to 9 lines long, straight ; the articles when young inclined to twist or infold, glabrate, or at length glabrous, except the margin. — This is wholly distinct from the perennial D. Wrightii, and is a smaller and more delicate plant.

D. EXIGUUM (sp. nov.): annuum, puberulum ; caule tenello erecto ramoso ; stipulis bracteisque setaceis ; foliis plerisque unifoliolatis, foliolo inferiorum deltoideo vel rhomboideo summorum lineari, paucis intermediis nunc trifoliolatis foliolis linearibus vel lanceolatis ; racemis filiformibus ; lomento 2 – 3-articulato longiuscule stipitato, articulis rhombeis scabris. — Mountain ravines, on the Sonoita, Sonora ; Sept. (1010.) — Stem a span high, diffusely branched. Leaflets hirtello-puberulent, not reticulated, obtuse ; those of the lowest leaves 3 to 5 lines long and 5 or 6 broad ; the next longer, and often deltoid-oblong, passing into lanceolate ; the upper, and those of the trifoliolate leaves when present, 6 – 9 lines long, and one or two wide. Pedicels capillary, an inch long. Flowers very small. Stipe of the loment three or four times the length of the calyx. Articles $1\frac{1}{2}$ to 2 lines long. — From D. Wislizeni this well-marked species (which belongs, like all the following, to the section Chalarium) differs in its annual root, its less reticulated and smaller leaflets, the lower strikingly dilated, and in the scabrous articles of the loment, which are more contracted at each end.

D. Neo-Mexicanum, *Gray, Pl. Wright. p.* 53; var. glabellum, caulibus erectis diffuse ramosis; foliolis membranaceis vix reticulatis obtusis; lomento glabello. — Borders of thickets, on stony hills along the Coppermine Creek, New Mexico; also in Sonora, along with the preceding species; Aug., Sept. (1011.) — Stems a span to a foot long from an annual root, erect, with the basal branches diffusely spreading. Leaves thinner and less rigid than in Wright's No. 141; the primordial ones unifoliolate, and oblong or oval. Corolla purple, two lines long. Articles of the loment almost glabrous, plane. — Cultivated in the Cambridge Botanic Garden, this forms a much-branched plant, three or four feet high, the branches very slender.

D. Bigelovii (sp. nov.): annuum; caulibus gracilibus procumbentibus elongatis angulatis scabrido-pubescentibus; foliis trifoliolatis; stipulis bracteisque setaceo-subulatis persistentibus; foliolis lato-lanceolatis obtusis membranaceis laxe venosis ciliatis glabellis; racemis laxifloris; lomento vix stipitato 3 – 4-articulato, articulis rhomboideis undulato-torquatis subpuberulis. — Valley on the San Pedro, Sonora; Sept. (1012.) — From the wild specimens I was inclined to consider this a doubtful variety of D. Neo-Mexicanum; but in cultivation it proves to be distinct. The slender stems trail on the ground, and attain several feet in length; the leaflets are much broader (3 to 5 lines wide by 12 to 18 in length), blunter, and thinner; and the articles of the pod are thin, undulate, and twisted; while in D. Neo-Mexicanum they are perfectly plane.

D. batocaulon (sp. nov.): caule elongato procumbente pilis tortis uncinatis aspero-hirto adhæsivo; stipulis e basi lata subulato-aristatis fuscis deciduis; foliis trifoliolatis; foliolis oblongo-lanceolatis acutis utrinque strigoso-hirsutis cinereis laxe venosis; racemis terminalibus et axillaribus laxifloris; bracteis subulatis caducis; lomento breviter stipitato, 5 – 7-articulato, articulis rotundatis lævibus. — Stony banks of small streams, on the San Pedro, Sonora; Sept. (1013.) — Stems numerous from the perennial root, trailing, striate-angled, three feet or more in length, rough with the rigid and adhesive pubescence. Leaflets 12 to 18 inches long, and 3 to 6 lines wide, somewhat canescent underneath. Axillary racemes few-flowered; the terminal many-flowered. Flower purple, 3 or 4 lines in length, as long as the pedicel. Articles of the fruit 2½ lines long, nearly smooth and glabrous.

D. Sonoræ (sp. nov.): caule erecto ramoso pilis apice uncinatis confertis aspero-hirto adhæsivo; stipulis bracteisque parvis e basi lata subulatis fuscis deciduis; foliis trifoliolatis; foliolis oblongis seu lanceolato-oblongis obtusis membranaceis laxe venosis utrinque parce pilosulis subtus pallidis; racemis terminalibus elongatis; lomentis deflexis brevissime stipitatis, articulis 7 – 8 rotundatis scabro-hirtis. — Low valley, on the Sonoita near Deserted Rancho, Sonora; Sept. (1014.) — Stem tall, the base not seen, clothed with a stiff adhesive pubescence much like that of the foregoing species; from which, besides its upright growth, it is distinguished by its less hairy, or glabrate, thinner and larger (1½ – 2½ inches long and 8 – 10 lines wide), obtuse leaflets, and the hirsute-scabrous articles of the loment. The latter are only a line and a half in diameter. It should be compared with D. Aparines, *DC.*

D. Grahami (sp. nov.): caulibus e radice perenni ramosis procumbentibus ramisque gracilibus glabellis; stipulis subulato-acuminatis fuscis persistentibus; foliis trifoliolatis; foliolis ovato-rotundis sæpe retusis membranaceis minute pubescentibus subtus pallidis; racemis plerisque terminalibus demum prælongis sparsifloris; bracteis ovatis acuminatis striatis calyceque primum hispidis deciduis; lomento substipitato deflexo, articulis 4 – 5 ovalibus inæquilateris pubero-scabris. — On mountains, near the copper mines, New Mexico; Aug. (1015.) — Stems much branched from the root, procumbent or decumbent, angled, leafy. Stipules rather small, soon deflexed. Petioles short; the lower little longer, the upper much shorter, than the rhachis, which is half an inch long. Leaflets 12 to 18 lines long by 8 to 14 wide, bright green above, clothed with a fine appressed pubescence which is shorter and sparse underneath. The principal terminal raceme becomes, with its peduncle, a foot and a half long. Flowers in the bud imbricated with the broad bracts (which are 2 – 3 lines long), but are soon sparse. Pedicels 3 or 4 lines long, roughish-pubescent. Corolla purple, 3 or 4 lines long. Loment straight, slightly sinuate on the upper side, deeply lobed on the lower; the articles therefore inequilateral, 3 lines long. — A fine species, the aspect of the foliage much like that of D. Dillenii; from which the rounded leaflets, decumbent habit, larger bracts, and simple prolonged racemes, at once distinguish it. I dedicate the plant to Colonel Graham, to whose staff Mr. Wright was attached when this collection was made.

D. psilocarpum (sp. nov.): scabro-pubescens; caule e basi suffrutescente erecto; stipulis ex ovato longe subulatis striatis persistentibus; foliis trifoliolatis; foliolis rhombeo-ovatis oblongisve obtusis reticulatis glabratis marginibus venisque subtus hirtellis; racemis terminalibus paniculatis multifloris; bracteis stipulis conformibus caducis; lomentis patentibus, articulis 4 – 5 medio adnexis ovalibus subæquilateris glaberrimis (nisi margine ciliolatis) membranaceis semine multo majoribus. — On detritus of a mountain ravine, near Santa Cruz, Sonora; Sept. (1016.) — Stem 2 or 3 feet high, rigid, roughish with a fine hooked pubescence and some hirsute hairs. Stipules conspicuous, 4 – 5 lines long, green. Stipels setaceous, longer than the petiolules. Leaflets chartaceous, one or two inches long, or sometimes smaller, of nearly the same hue both sides, reticulated underneath, mucronate. The flowering racemes are probably rather dense; the fructiferous ones are often nearly a foot long, and bear a large number of pods. The late flowers at the summit of the spent racemes are small, only two lines long; the calyx-teeth subulate. Pedicels half an inch long. Loment slightly stipitate, smooth and glabrous even when young, except a fine pubescence on the margins; the articles four lines long, thin, appearing broadly winged around the contained seed. — This species is related to D. canescens; from which it is distinguished by its smaller and blunter leaflets, of nearly the same hue both sides, by the absence of villosity on the inflorescence, &c., and by the smooth loments, the two sutures of which are equally constricted. It should be compared with D. stipulaceum, *DC.*

D. cinerascens (sp. nov.): decumbens e radice perenni, pube molle appressa cinereum; stipulis lineari-subulatis fuscis deciduis; foliis trifoliolatis; foliolis ellipticooblongis obtusis parallele penninerviis utrinque sericeo-pubescentibus pallidis subtus

canescentibus; racemis ad apicem caulis paniculatis multifloris; bracteis subulatis caducis; lomentis adscendentibus breviter stipitatis, articulis 6 – 8 ovalibus inæquilateris puberulis. — Hills, between Barbocomori and Santa Cruz, Sonora; Sept. (1017.) — "Stems 2 to 4 feet long, procumbent." Stipules two lines long. Petioles an inch or less in length, longer than the rhachis. Leaflets 1½ to 2 inches long, 7 to 12 lines wide, very obtuse at both ends, cinereous with a very soft pubescence; the straight primary veins, five or six on each side, very prominent underneath (in the manner of D. Canadense and D. cajanifolium); the veinlets reticulated. Flowers purple, smaller than in D. Canadense. Loment more deeply constricted on the under than the upper side; the articles 2½ lines long. — This species bears some resemblance to D. strobilaceum; which has very short petioles, much larger flowers and bracts, and a lax pubescence; and D. cajanifolium, which has much longer oblong-lanceolate leaflets, green and smooth above, &c.: the form of the pod, as well as of the leaflets, is different from that of D. incanum; and the procumbent or decumbent mode of growth is different from all these species.

Crotalaria lupulina, *DC. Prodr.* 2. *p.* 133. Valleys in the Chiricahui Mountains, Sonora; Sept. (1018.)

C. sagittalis, *Linn.* Hill-sides, near Santa Cruz, Sonora; Sept. (1019.)

Lupinus Mexicanus, *Lagasca, Nov. Gen. & Sp. p.* 22; *Bot. Reg. t.* 457. Mountains near the copper mines, New Mexico (July, in flower, *Dr. J. M. Bigelow*), Oct.; in fruit. (1020.) — "Ascending, about two feet high. Spike in fruit often more than a foot long." — The flowering specimen is small, only a foot high, and villous-hirsute, except the upper face of the leaves. Those in fruit, from the same locality later in the season, are much less hairy. Root perennial. Leaflets 8 to 10, from one to 2½ inches long. Flowers pretty large, blue or purple. Bractlets minute. Upper lip of the calyx acutely emarginate – 2-cleft at the apex, the lower 3-denticulate or entire. Carina ciliate-bearded along the upper part, more so than in L. Ehrenbergii. Legume strigose-pubescent, an inch and a half long, 4 or 5 lines wide, flat; 4 – 5-seeded. — Our plant accords so well with the figure in the Botanical Register (made from specimens raised from seeds communicated by Lagasca to Mr. Lambert) that I cannot think it different. The leaflets, to be sure, are said to be only from 5 to 7 in the original character; but they are 7, 8, and even 9 in the plant figured; nor is the calyx represented as with the upper lip much if at all more cleft than in our specimens, which, in this respect, agree with the closely allied L. Ehrenbergii.

L. pusillus, *Pursh, Fl.* 2. *p.* 468; *Torr. & Gray, Fl.* 1. *p.* 374; var. leguminibus brevioribus (fere semipollicaribus) ovalibus. — Sandy ridges on the Rio Grande opposite Frontera, March, in flower; and plains at the base of the Organ Mountains, May, with fruit. (1362.)

Sophora sericea, *Nutt.; Gray, Pl. Wright. p.* 54. On the Limpio, June; in fruit. Near San Elisario and Lake Santa Maria, April; in flower. (1021.)

Hoffmanseggia Jamesii, *Torr. & Gray, Fl.* 1. *p.* 393; *Gray, Pl. Wright. p.* 54. Valley of the Pecos, in stony prairies; June. Prairies from the Mimbres to the copper mines, New Mexico; July. (1022.) "Root a large woody tuber."

H. BRACHYCARPA, *Gray, Pl. Wright. p.* 55. High rocky (limestone) prairies of Elm Creek, Turkey Creek, and the San Pedro, Western Texas, May; mostly in fruit. (1023.)

H. OXYCARPA, *Benth. in Pl. Wright. l. c.* Stony prairies of Piedra Pinta Creek, May; and on the San Pedro, June. (1024.)

H. STRICTA, *Benth. in Pl. Wright. p.* 56. Valley of the Pecos, in alluvial soil, June. (1025.)

H. STRICTA, var. DEMISSA, *Pl. Wright. l. c.* Valley of the Rio Grande below Doña Ana, and at El Paso; April, July. (1026.) — It passes manifestly into the taller form.

H. DREPANOCARPA, *Gray, Pl. Wright. p.* 58. Stony prairies, valley of the Pecos; June. Sandy hills near El Paso and Doña Ana, New Mexico; May. (1027.) — "Flowers sweet-scented." — A plant raised from the seed is glaucous; and the weak scapes are decumbent, or prostrate in fruit.

CERCIDIUM TEXANUM, *Gray, Pl. Wright. p.* 58. Stony prairies of the Piedra Pinta, &c., Western Texas; May. (1028.)

CASSIA RŒMERIANA, *Scheele; Gray, Pl. Wright. p.* 59. Stony prairies, Zoquete Creek, Texas; May. (1029.)

C. BAUHINIOIDES, *Gray, Pl. Lindh.* 2. *p.* 180, & *Pl. Wright. l. c.* Valleys, near Eagle Springs, between the Limpio and the Rio Grande; June. Also on sandy ridges, west of the Chiricahui Mountains, Sonora; Sept. (1030.)

C. PUMILIO, *Gray, l. c.* Along the San Pedro and Pecos, Western Texas; May. (1031.)

C. LEPTOCARPA (*Benth. in Linnæa*, 22. *p.* 528): glabra, herbacea; caule erecto (2–3-pedali); petioli basiglanduloso; foliolis 4–6-jugis ovato-lanceolatis acuminatis; racemis brevibus paniculatis, infimis folio brevioribus; floribus aureis; legumine attenuato-lineari prælongo compresso marginato recurvato! (Cæt. fere C. occidentalis.) — Pebbly bed of mountain streamlets, near the San Pedro, Sonora; Sept. (1032.) — The gland at the base of the petiole is oblong and acute. The leaflets are smaller than is usual in C. occidentalis (from one to barely two inches in length), and the flowers in the dried specimens are much deeper-colored. But the principal character is furnished by the pods, which (even when very immature) are eight inches long, and only a line and a half wide, tapering upwards, and arcuate-recurved, as in C. obtusifolia. Ripe seeds not seen; their longer diameter lengthwise in the pod. — From the character this must be the C. leptocarpa, which was gathered in Brazil.

C. (CHAMÆSENNA) WISLIZENI, *Gray, Pl. Wright. p.* 60: adde char.: ramis spinescentibus; legumine lineari plano vernicoso, valvis chartaceis. — Heads of the Agua Prieta, Sonora; Oct. (1033.) — "A much-branched and spreading shrub, 4 to 6 feet high." Leaflets often three pairs, 2 or 3 lines long, thickish. Legumes 4 or 5 inches long, 3 lines wide, very flat and thin, obtuse or apiculate, somewhat stipitate, many-seeded; the surface appearing as if covered with a shining varnish. It belongs to the section Chamæsenna.

C. (CHAMÆCRISTA) WRIGHTII (sp. nov.): glabra, humilis; caulibus assurgentibus plurimis e radice crassa perenni; stipulis subulatis; foliolis 4–7-jugis lineari-ellip-

ticis mucronulatis; glandula clavuliformi stipitata infra par infimum; pedicellis axillaribus subsolitariis folium subæquantibus; sepalis membranaceis acutis subcoloratis haud striatis, minoribus lanceolatis, majoribus ovatis; legumine acutato vel apiculato. — Hill-sides, on the Sonoita, near Deserted Rancho, Sonora; Sept. (1034.) — Root very thick and rather ligneous, sending up numerous stems 6 or 8 inches high. Petiolar gland small, raised on a slender setiform stalk, nearly as broad as itself. Leaves an inch long; the leaflets 3 or 4 lines long, much fewer and less inequilateral than those of C. Chamæcrista; the pedicels longer in proportion. Flowers showy; the sepals 3 or 4 lines long, often reddish, shorter than the bright yellow petals. Pod glabrous or nearly so, an inch and a half long, often abruptly pointed at both ends, 8 – 10-seeded.

Algarobia glandulosa, *Torr. & Gray, Fl.* 1. *p.* 399; *Pl. Wright. p.* 60. On the Rio Grande, near San Elizario; May.

Strombocarpa pubescens, *Gray, Pl. Wright. p.* 60. Prosopis (Strombocarpa) pubescens, *Benth.* P. (Strombocarpa) Emoryi, *Torr. in Emory, Rep. p.* 139. Valley of the Rio Grande, below and above El Paso; June, July. (1035.)

Desmanthus velutinus, *Scheele in Linnæa*, 21. *p.* 456. Rocky hills, valley of the Pecos; and Elm Creek, Western Texas; June. (1036.) — Probably a variety of the next.

D. Jamesii, *Torr. & Gray, Fl.* 1. *p.* 402, & var. *Gray, Pl. Wright. p.* 63. Prairies, on the Mimbres, New Mexico; July.

Mimosa fragrans, *Gray, Pl. Lindh.* 2. *p.* 182, & *Pl. Wright. p.* 61. Prairies on the San Pedro, Western Texas (in fruit); May. (1037.)

M. borealis, *Gray, Pl. Fendl. p.* 39. Rocky hills, valley of the Pecos (in fruit); June. (1038.)

M. Lindheimeri, *Gray, Pl. Lindh.* 2. *p.* 181.? var. pinnis 3-jugis (nunc 1 – 2-jugis in ramulos floridos); foliolis 5 – 7-jugis; leguminibus rectiusculis margine aculeis crebris uncinatis horridis. — Prairies at the head of the Los Moros, Western Texas, July; in flower and fruit. (1363.) — "A low and spreading or procumbent bush, 1 to 4 feet high. Flowers light purple." — Apparently only a form of M. Lindheimeri, with the pinnæ and leaflets reduced more or less, and the margins of the pod excessively armed.

M. biuncifera, *Benth.; Gray, Pl. Wright. p.* 61. Between El Paso and Western Texas, 1832; in flower. (1364.)

M. biuncifera, var. glabrescens. — Hills on the Sonoita, Sonora, Sept.; in fruit. (1039.) — "Procumbent, branched from the root, the branches 2 to 3 feet long." — M. Lindheimeri too closely approaches this form.

M. flexuosa, *Benth. in Pl. Wright. l. c.* Hills, from Rainwater Creek to the Limpio, June; in flower. (1365.) — Calyx and corolla tomentulose or cinereous-pubescent, like the slender branches.

M. dysocarpa, *Benth. in Pl. Wright. p.* 62. Mountain valleys, between the Limpio and the Rio Grande, June; in flower. (1366.)

M. dysocarpa; var. minus villosa; ramis herbaceis; aculeis petiolorum etiam validis. — Stony hills at the copper mines, New Mexico; Aug. (1040.) — The flat

cauline prickles are 4 or 5 lines long, and often 3 lines wide at their base. The stems are apparently procumbent.

M. Wrightii (sp. nov.): suffrutescens, sericeo-puberula; caulibus (decumbentibus?) aculeis sparsis brevibus rectis armatis; stipulis subulatis; petiolis parce aculeolatis; pinnis 7 – 10-jugis; foliolis 10 – 15-jugis dimidiato-oblongis fere aveniis mucronulatis supra glabratis subtus sericeis; spicis cylindricis; floribus 4 – 5-meris 8 – 10-andris glabriusculis; calyce corolla dimidio breviore; ovario pubescente. — Hill-sides on the Sonoita, Sonora; Sept. (1041.) — "Many stems from the same root, two or three feet long." Stems slender, striate-angled, in the specimens mostly simple and herbaceous (the base not seen), copiously armed with straight and conical, or slightly flattened, scattered prickles, which are from one to two lines in length. Rhachis with the petiole 2 to $3\frac{1}{2}$ inches long, armed with a few minute prickles. Pinnæ 7 – 9 lines long. Leaflets $1\frac{1}{2}$ to barely 2 lines long, half a line wide. Spikes axillary, and somewhat panicled or racemose at the summit of the stem, one to two inches long, densely flowered. Calyx and corolla minutely puberulent, membranaceous; the latter broadly funnel-form, a line and a half long. Stamens three or four times the length of the corolla. Legume not seen; the specimen being in flower only. — This would appear to be related to M. puberula, *Benth. in Hook. Lond. Jour. Bot.* 5. *p.* 88; but that is described as unarmed, and with larger leaflets.

M. Grahami (sp. nov. Ameria, Acanthocarpæ): frutescens, decumbens, glabra; caule aculeis infrastipularibus geminis rectis cum paucis sparsis subrecurvis armato; rhachi communi sæpeque partialibus aculeolis recurvis raris obsitis; stipulis setaceis; pinnis 6 – 8-jugis; foliolis 10 – 15-jugis oblongis venosis; pedunculis folio brevioribus; capitulis globosis; floribus glabris 5-meris; corolla calyce brevissime dentato triplo longiore; legumine oblongo-lineari recto glabro margine rariter aculeolato vel inermi. — Mountain valleys of Sonora, between the San Pedro and the Sonoita; Sept. (1042.) — "Stems many from the root, one or two feet high, procumbent," rather stout and rigid, lignescent; the base probably truly woody. Infrastipular prickles 2 or 3 lines long, straight: on some stems there are a number of (similar, but more or less recurved) scattered prickles besides; on others, scarcely any. The small prickles on the leaves (on the main rhachis and often on its branches also) are hooked. Rhachis with the petiole 3 or 4 inches long: pinnæ about an inch long. Leaflets 2 – 3 lines long, oblong or ovate-oblong, mucronulate, oblique, coriaceous, 3 – 5-nerved at the base, and pinnately veined from the midnerve (the veins conspicuous and somewhat reticulated underneath), glabrous, except a few minute and scattered hairs along the margins, and on the rhachis. Peduncles axillary, 7 – 18 lines long. Bracts minute. Corolla a line and a half long. Pod an inch to an inch and a half long, three lines wide, straight, obtuse, glabrous; the margin beset with two or three minute prickles on each side, or else naked; the valves thick and coriaceous, separating entire from the margin at maturity. Seeds 5 or 6.

Calliandra Chamædrys, *Engelm. in Pl. Fendl. p.* 39; var. pinnis nunc 4-jugis (2 – 4-jugis); foliolis magis sericeo-pilosis (1 – $2\frac{1}{2}$ lin. longis); pedunculis gracili-

bus (8 – 12 lin. longis.) — Stony soil, between the copper mines, New Mexico, and the Chiricahui Mountains; Sept. (1043.) Also between the Leona and Rio Frio, Western Texas; July. (1367.) — Stems upright, a foot or more high, from a thick woody caudex. Pods 2 – 3 or even 4 inches long, strigosely silky-canescent, tapering from the middle to the base, but not truly stipitate. — Engelmann described the species from Gregg's stunted specimens: these are well-developed ones; those from New Mexico are more silky-pubescent; so that I fear the species is hardly distinct from C. eriophylla, *Benth.*

C. CONFERTA, *Benth. in Pl. Wright. l. c.* Limestone hills near the San Pedro, Western Texas; July. (1368.)

C. HUMILIS, *Benth. in Lond. Jour. Bot. 5. p.* 103. C. herbacea, *Engelm. in Pl. Fendl. p.* 39; *Gray, Pl. Wright. p.* 63. Hill-sides of the Limpio, and westward; June. Also at the copper mines; and near Santa Cruz, Sonora; Sept. (1044.) — The stems are herbaceous nearly to the base, at most a span high, from a lignescent, very long and horizontal root. The pubescence is either copious, or at length nearly all deciduous. Pinnæ 3 – 6 pairs, 1 – 2 inches long. Most of the capitula are on peduncles of about an inch in length, while others are sessile or nearly so. The very young pods are hirsute; the mature ones hirsute-puberulent or glabrate: valves coriaceo-membranaceous, with very thick margins. "Stamens pale red."

C. RETICULATA (sp. nov.): pilosa, mox glabrata; caulibus spithamæis diffusis subherbaceis e radice magna lignescente; stipulis ovatis nervosis; pinnis 1 – 3-jugis; foliolis 4 – 11-jugis ovalibus obtusissimis obliquis 3 – 5-nerviis laxe reticulatis supra nitidulis glabris; pedunculis petiolo communi subæquilongis; calyce ad medium fere 5-fido hirsuto corolla glabriuscula dimidio breviore; legumine glabello, valvulis membranaceo-coriaceis marginibus incrassatis. — Stony hills at the copper mines, New Mexico; Aug. (1045.) — Manifestly related to the foregoing, and with the same low and nearly herbaceous stems from a lignescent root, which is one or two feet long. But the pinnæ (1 to $2\frac{1}{2}$ inches long) are rarely more than two pairs, and the leaflets are from 3 to 5 lines long, $1\frac{1}{2}$ to $2\frac{1}{2}$ lines wide, more conspicuously nerved and reticulated; and the calyx is fully half the length of the corolla. Stipules rigid, 2 lines long, ovate, or the uppermost oblong or lanceolate. "Filaments pink," exserted 3 or 4 lines. Immature legumes as in C. humilis.

LEUCÆNA RETUSA, *Benth. in Pl. Wright. p.* 64. Pebbly banks of the Rio Frio, Texas, and west to the Limpio, May, June. (1046.) — "Stems much branched from the root, 4 – 6 feet high."

ACACIA WRIGHTII, *Benth. in Pl. Wright. p.* 64. Prairies of the Rio Frio, to Los Moros, Texas. (1047.) — "A spreading bush, 4 to 10 feet high."

A. GREGGII, *Gray, Pl. Wright. p.* 65. Hills of Live Oak Creek, Western Texas; May. Also between Van Horne's Wells and the Rio Grande; June. (1048.)

A. COULTERI, *Benth. in Pl. Wright. p.* 66. Prairies between Piedra Pinta Creek and Los Moros; July. (1369.) — The specimens are in flower, with a single ripe pod of the preceding year. The shrub is said to be from 4 to 6 feet high; the branches are armed with a few minute prickles. The pinnæ are 5 to 6 pairs. The densely-flowered spikes are oblong or cylindrical, not over an inch in length and

often much shorter; and the peduncle an inch or an inch and a half long. By an error in transcribing, in *Plantæ Wrightianæ* the flowers are said to be $2\frac{1}{2}$ inches, instead of $2\frac{1}{2}$ lines, in length.

A. TEPHROLOBA, *Gray, l. c.* Stony prairies, Zoquete Creek, &c., Western Texas, May; in flower and with young fruit. Big bend of the San Pedro, July; with ripe fruit. (1049.) — "Shrub 1 – 2 feet high."

A. CONSTRICTA, *Benth. in Pl. Wright. p.* 66. Stony hills, from the Limpio to the Rio Grande; May, June (in flower and fruit). Also in valleys of the Agua Prieta, Sonora, Sept.; in fruit. (1050.)

A. CUSPIDATA, *Schlecht. in Linnæa*, 12. *p.* 573; *Gray, Pl. Wright. p.* 66. Stony hills, at the copper mines; Aug. - (1051.)

A. RŒMERIANA, *Scheele in Linnæa*, 21. *p.* 546. Rocky hills of the San Pedro, Texas, May; in fruit. (1052.)

ROSACEÆ.

CERASUS (MICROSERASUS) MINUTIFLORA, *Engelm. in Pl. Lindh.* 2. *p.* 185; *Gray, Pl. Wright. p.* 68. Stony hills of San Felipe Creek, Texas, May; in fruit. (1053.)

C. VIRGINIANA, *DC.*; var. foliis parvulis subtus molliter pubescentibus pallidis. — Sides of mountains, at the copper mines, New Mexico, Aug.; in fruit. (1054.) The same as Fendler's No. 186.

C. CAPOLLIN, *DC. Prodr.* 2. *p.* 539; *Benth. Pl. Hartw. p.* 10. Banks of a torrent between Rock Creek and the Limpio, June; in fruit. (1370.) — This is exactly Hartweg's No. 48, and Coulter's No. 89; all with broader leaves than is described by De Candolle, namely, oblong-ovate. No. 623 of Gregg's collection, from Real del Monte, however, accords with the character, having leaves of about the shape and size of those of Salix fragilis. I think all of them are no more than varieties of C. serotina.

SPIRÆA DUMOSA, *Nutt. in Hook. Lond. Jour. Bot.* 6. *p.* 217. New Mexico; probably with the next. The same as Fendler's No. 188.

S. DUMOSA; var. foliis majoribus rotundatis haud cuneatis; panicula ampla nutante ut in S. ariæfolia. — Sides of hills at the copper mines, New Mexico; Aug. (1055.) — "A slender bush, 6 – 10 feet high."

CERCOCARPUS PARVIFOLIUS, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 427; var. foliis subintegris parvis (5 – 10 lin. longis). — Hill-sides, along Coppermine Creek, New Mexico; Aug. (1056.) — Shrub 6 to 8 feet high. The same as No. 183 of Wright's first collection; but the leaves still smaller.

C. BREVIFLORUS (sp. nov.): foliis spathulato-oblongis integris sessilibus utrinque sericeo-puberulis; floribus plerisque geminis sessilibus; tubo calycis limbo breviore. — Sides of mountains near Frontera, New Mexico; July. (1057.) — "Shrub 2 – 4 feet high, much branched; the branches tortuous, spinescent. Leaves 4 to 6 lines long, minutely silky-pubescent and of nearly the same hue both sides, entire, or obscurely 2 – 3-toothed at the apex. Flowers shorter than the leaves, closely sessile; the pedicelliform tube at most a line in length, usually still shorter; the

expanded limb 2 lines in diameter. Fruit not seen. Style villous below. — The smallest of all the species, both for the leaves and the flowers.

Cowania Mexicana, *Don in Linn. Trans.* 14. *p.* 574. *t.* 22; *Benth. Pl. Hartw. p.* 16. Hills on the Sonoita, near Deserted Rancho, Sonora; Sept. (1058.) — "Shrub 6 to 10 feet high, with short and stout branches." The petals would appear to have been ochroleucous, at most sulphur-colored; but Mr. Wright assures me that they were *white* in the living plant, which is also stated of Geum? dryadoides, *DC.* Were the flowers of Don's plant truly yellow?

Fallugia paradoxa, *Torr. in Emory's Rep. t.* 2; *Gray, Pl. Wright. p.* 68. On the Pecos, Western Texas, in alluvial soil; June. (1059.)

Potentilla paradoxa, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 437; *Gray, Pl. Wright. p.* 68. Sand-bars of the Rio Grande near El Paso and Frontera; July. (1060.)

Rubus Neo-Mexicanus (sp. nov.): inermis, fruticosus; ramis glabellis eglandulosis; foliis rotundo-cordatis breviter 3 – 5-lobis molliter pubescentibus, lobis argute serratis subincisis; stipulis lanceolatis; pedunculis 1 – 2-floris sepalisque apice caudatis parce glandulosis; petalis albis orbiculatis calyce longioribus; carpellis numerosis rubris. — Mountain-sides at the copper mines; Aug., in flower; Oct., in fruit. (1061.) — Stems 3 – 5 feet high, much branched, glabrous; the branchlets pubescent, but not glandular nor hispid, slender. Stipules proportionally larger than in R. Nutkanus. Leaves one to 2½ inches in diameter, with short and roundish or obtuse lobes, or the terminal lobe acute; when old, the surface is somewhat plicate and rugose. Peduncles about an inch long. Corolla, when expanded, an inch in diameter. — Manifestly related to R. deliciosus, *Torr.*, which has purple flowers.

Rosa blanda, *Ait.*, var. *β. Torr. & Gray.* Valley of the Limpio, especially at Wild Rose Pass, to which it gives the name; June.

LYTHRACEÆ.

Ammannia Wrightii (sp. nov.): caule erecto; foliis lineari-lanceolatis basi auriculatis imis oblongis basi attenuatis sessilibus; pedunculis 1 – 5-floris floribus longioribus; calycis dentibus propriis atque accessoriis brevissimis; petalis et staminibus 4; stylo longiusculo. — Margin of pools and mountain streams east of Santa Cruz, and along the San Pedro, Sonora; Sept. (1062.) — Root annual. Stems 2 to 7 inches high. Leaves 6 to 12 lines long, rather obtuse. Peduncles 3 to 5 lines long; the pedicels 1 to 2 lines long. Bracts linear-subulate. Calyx a line and a half long. Petals orbicular, purple, about the length of the stamens and style. Capsule 2-celled. — The conspicuously pedunculate flowers at once distinguish this from all other North American species.

A. dentifera (sp. nov.): humilis; caule erecto; foliis oblongo-linearibus omnibus basi attenuatis subsessilibus; floribus solitariis sessilibus apetalis tetrandris; calycis dentibus accessoriis subulatis patentibus proprios triangulares conniventes triplo excedentibus. — East of Santa Cruz, Sonora, with the preceding. (1063.) Also at Santa Cruz (a dwarf form, only an inch high). — This species much resembles A. humilis; but it has prolonged and conspicuous accessory calyx-teeth. The stamens are included and the style very short in all the specimens.

Cuphea Wrightii (sp. nov.): annua; caule gracili ramoso adscendente calycibusque setis rubellis subviscosis hispidis; foliis oppositis longe petiolatis ovatis basi rotundatis subacuminatis glabellis; floribus plerisque racemosis; pedicellis binis vel ternis e singulis bracteis quorum superioribus alternis; calyce basi subcalcarato, fauce imberbi, dente postico multo majore; petalis 6; staminibus 11; filamentis basi pilosis; ovario 3-ovulato. — Hills near Santa Cruz, Sonora; Sept. (1064.) — Stems 5 to 10 inches high, slender, sparingly branched. Leaves 8 to 12 lines long, on petioles of half their length, thin, with inconspicuous veins, not scabrous. Flowers solitary or 2 to 3 together in the axils of the upper leaves, and crowded in a terminal raceme; the upper bracts becoming minute, and chiefly alternate. Calyx about as long as the pedicels, $2\frac{1}{2}$ to 3 lines in length, shaped nearly as in C. viscosissima, except that the upper tooth is proportionally larger, and the throat is not bearded within, purplish. Petals $1\frac{1}{2}$ line long, purple. Stamens included: anthers glabrous. Style glabrous. Seeds smooth.

Nesæa longipes, *Gray, Pl. Wright. p.* 68. Comanche Spring, Texas. (1371.)

ONAGRACEÆ.

Epilobium coloratum, *Muhl.* Head of the Limpio, in water; June. (1065.)

Zauschneria Californica, *Presl, Rel. Hænk.* 2. *t.* 52; *Torr. & Gray, Fl.* 1. *p.* 486 (fere var. *β.*). Pebbly bed of mountain streams near the San Pedro, Sonora; Sept. (1372.)

Z. Californica; var. foliis glabellis brevibus oblongis vel ovato-oblongis e basi lata sessilibus, inferioribus denticulatis, superioribus integerrimis; floribus intense rubris. — Pebbly bed of a mountain torrent on the New Mexican side of the Chiricahui Mountains; Sept. (1373.) — This variety of this very showy plant considerably resembles the var. latifolia, *Bot. Mag. t.* 4493.

Œnothera biennis, var. hirsutissima, *Gray, Pl. Fendl. p.* 43. Margin of Coppermine Creek, New Mexico; and on the Sonoita, Sonora. (1066.)

Œ. albicaulis, *Nutt.*; var. subcinerea, ramosissima, lignescens, subpinnatifida, *Gray, Pl. Wright. p.* 69. — Sandy soil on the Rio Grande at Doña Ana, New Mexico; July. (1067.) — The same as No. 191 of the former collection. The seeds are fusiform-cylindraceous and smooth, neither striate nor punctate (so that Nuttall's description of them, in *Torr. & Gray, Fl. N. Amer.*, must refer to those of Œ. coronopifolia).

Œ. albicaulis; var.? foliis oblongis sinuato-dentatis vel subpinnatifidis cinereo-puberulis vel glabratis; ramis junioribus capsulis calycibusque hirsuto-villosis. — Sandy bed of a creek near the copper mines, Aug. (1068.) — The flowers are large; the tube of the calyx and the petals being an inch long. The scarcely mature pods are rather short for this species; but the seeds are oblong and perfectly smooth. The calyx in the bud is clothed with long villous hairs, in some specimens very copiously; so that this plant may be Nuttall's Œ. trichocalyx.

Œ. coronopifolia, *Torr. & Gray, Fl.* 1. *p.* 495; *Gray, Pl. Fendl. p.* 43. Valleys near the copper mines, New Mexico; Aug. (1069.) — A form with the pods longer than in Fendler's No. 222 ($1-1\frac{1}{2}$ inches long); but the seeds, as in that plant, are

turgid-oval or subglobose, apiculate, longitudinally striate-ribbed, and punctate between the ribs.

Œ. CORONOPIFOLIA; var. calycibus hirsuto-villosis seu villosissimis. — Valley of the Pecos, in alluvial soil; June. (1070.) — Seeds striate and punctate, as in the preceding.

Œ. ROSEA, *Ait.*; *DC. Prodr.* 3. *p.* 51. Hartmannia gauroides, *Spach*, *Monogr. Onagr. p.* 41. On steep banks of the San Pedro, Sonora; Sept. (1071.) — Also collected by Coulter (No. 165), and by Gregg (Saltillo, and San Angel, near Mexico).

Œ. (MEGAPTERIUM) WRIGHTII (sp. nov.): subcaulescens e caudice perenni, cinereo-puberula; foliis lanceolato-oblongis acutis mucronatis venosis dentatis basi plerumque laciniatis seu lyrato-pinnatifidis petiolatis; laciniis calycis tubo multo brevioribus petala flabelliformia subæquantibus; capsula immatura quadrialata. — Stony hills, near the copper mines, New Mexico; Aug. (1072.) — "Flowers open in the morning, withering early." The corolla is evidently yellow, and turns faintly rose-colored in fading, about as large as in Œ. Missouriensis (namely 2 to $2\frac{1}{2}$ inches long), the calyx (tube 5 or 6 inches long), stamens, stigmas, and immature seeds likewise similar. The leaves are herbaceous in texture, from 5 to 11 inches long, including the short petiole, an inch to an inch and a half wide, repand-denticulate or sharply and even doubly toothed, and commonly with 2 to 6 narrow and sharp lobes at the tapering base. The few and very immature capsules are sessile, an inch long, half an inch wide when flattened, canescent or sparsely hairy; the wings two lines wide, but obviously not fully developed.

Œ. WRIGHTII; var. vernalis, minor, magis canescens; foliis brevioribus ovatis oblongisve integerrimis vel plerisque lyratis. — Stony hills near Frontera, New Mexico; April. (1374.) — Root or caudex stout and deeply descending, bearing a rosulate tuft of leaves of 3 or 4 inches in length, and numerous flowers and young pods, and beginning to show short stems. Flowers smaller than in the foregoing; the petals scarcely more than an inch and a half in length. Immature pods an inch and a half long, about half an inch wide, narrowly ovate-oblong, tapering to the summit, sessile, cinereous-puberulent, 4-winged, the wings 2 to 3 lines in width; the texture chartaceo-coriaceous. Seeds packed in a double row in each cell, angled, with a thick testa, transversely corrugate below, the upper part winged in the manner of Œ. Missouriensis, but more decidedly so. — I can scarcely doubt that this is a vernal form of the preceding, and that it should be referred to the section Megapterium, although the wings of the pod are narrow. Except in the fruit it much resembles the following, which indeed belongs to the same section rather than to Lavauxia.

Œ. BRACHYCARPA, *Gray*, *Pl. Wright. p.* 70. Hill-sides on the Limpio; June. (1073.) — "Flowers expand about sunset." A specimen of this was also gathered on the mountains east of El Paso, in fruit, May. The larger pods are nearly an inch in length, cartilaginous in texture, with pretty thick walls; the angles very narrowly but distinctly winged. Seeds much as in the preceding, but with a thickened crest-like apex with a sharp edge, rather than winged.

Œ. TRILOBA, *Nutt.*; *Gray, Pl. Wright. p.* 70. Valley between the Salado and Lake Santa Maria, Chihuahua; April. (1375.) — This species has never before been found in the New Mexican region.

Œ. (PACHYLOPHIS?) PRIMIVERIS (sp. nov.): acaulescens, pygmæa, annua vel biennis; radice exili; foliis lyrato-pinnatifidis vel primordialibus integris lanceolato-oblongis ad margines costamque cum calyce villoso-pubescentibus; tubo calycis filiformi lobis (petala flava subæquantibus) multoties longioribus; capsulis ovoideo-conicis acutis leviter 10-costatis in collo sessilibus; seminibus ad chalazam suberoso-cristatis. — Dry hills near El Paso, Feb. – April. (1376.) — This little plant evidently springs from the seed in the autumn, or even in the winter, and flowers at the first opening of spring. Some of the specimens are barely an inch high; the leaves of the larger ones attain the length of 3 or 4 inches; and the tube of the calyx is one or two inches long. The petals, from 5 to 8 lines long, are pure yellow, not turning purplish. Anthers linear, fixed by the middle. Lobes of the stigma linear, distinct. Capsule 8 or 10 lines long, tapering from near the base to the apex, terete, somewhat hirsute, coriaceous; the ribs filiform, equal, not crested nor tuberculate. Seeds very numerous and biserial in each cell, oval, with a thick and rather corky testa, somewhat rugose, grooved along the rhaphe, and enlarged into a thick and short appendage at the chalaza. The plant is strictly acaulescent and probably disappears by the end of spring. The leaves become glabrate. Strictly speaking, this belongs to a new section analogous to Pachylophis.

Œ. (SALPINGIA) LAVANDULÆFOLIA, *Torr. & Gray*; *Gray, Pl. Wright. p.* 72. Prairies on the Pecos; June. (1074.)

Œ. HARTWEGI, *Benth.*; var. caulibus elongatis; foliis lanceolato-linearibus, *Gray, Pl. Wright. p.* 72. Stony hills of the Pecos; June. (1075.) — Same as Wright's No. 198; passing into

Œ. HARTWEGI, var. FENDLERI; major, foliis lanceolatis et oblongo-lanceolatis. — Œ. Fendleri, *Gray, Pl. Fendl. p.* 45. Declivities, on the Sabinal, Western Texas, May. (1076.)

Œ. TUBICULA, *Gray, Pl. Wright. p.* 71. Valley of the Pecos and toward the Limpio, in alluvial soil; June. (1077.)

Œ. (SPHÆROSTIGMA) CHAMÆNERIOIDES (sp. nov.): annua vel biennis, glabella; caule humili tenero e basi ramoso; foliis oblongis seu lanceolatis repandis subsessilibus, radicalibus subspathulatis in petiolum attenuatis; floribus racemosis primum confertis parvis purpurascentibus; tubo calycis infundibuliformi lobis subduplo ovario multoties longiore; petalis spathulato-oblongis integerrimis calycem stylumque æquantibus; capsulis elongatis filiformibus rectis sessilibus. — Stony hills along the Rio Grande near El Paso; March. (1377.) — Plant a span, or at length 9 or 10 inches high, erect, or the side branches from the base ascending, with wholly the aspect of a small Epilobium; the branches slightly viscous-pubescent. Radical leaves 1½ to 2 inches long, 3 to 5 lines wide; the cauline smaller; the later floral linear-subulate, much shorter than the ovary, and like it pruinose-puberulent. Calyx-tube scarcely a line and a half long. Petals less than a line long. Stigma large, globular. Pods 1½ to 2 inches long, filiform, terete, half a line in diameter, erect-

spreading, straight or slightly curved, 4-valved, exactly like that of an Epilobium; but the seeds are not comose.

Gaura sinuata, *Nutt. in DC. Prodr.* 3. *p.* 44. Valley of the Limpio; May.

G. suffulta, *Engelm. in Pl. Lindh.* 2. *p.* 190. Valley of the Pecos; May. Also valley of Coppermine Creek, New Mexico; Aug. (1078.)

G. villosa, *Torr.*; *Gray, Pl. Wright. p.* 73. Valley of the Limpio, in alluvial soil; June. (1079.)

G. coccinea, *Nutt.*, var. *Gray, Pl. Wright. p.* 73. Prairies from Zoquete Creek, Texas, to the Limpio and the Rio Grande near El Paso. (1080.)

G. parviflora, *Dougl.* Along the Rio Grande below El Paso; June.

Proserpinaca palustris, *Linn.* Margins of Chicon or Elm Creek, Western Texas; July. (1378.)

Myriophyllum heterophyllum, *Michx.*; var. foliis emersis parvulis. — With the preceding. (1379.) — The same as No. 202 of the former collection.

LOASACEÆ.

Mentzelia oligosperma, *Nutt.* Pass of the Chiricahui Mountains, Sonora; Sept. (1081.)

M. (Bartonia) multiflora, *Nutt.*; *Gray, Pl. Fendl. p.* 48, & *Pl. Wright. p.* 74. Valleys near Eagle Spring, east of the Rio Grande; June. Mountains near El Paso; April, in flower. (1082.) — Petals ochroleucous, or pale yellow, 7 or 8 lines long, opening at evening.

M. (Trachyphytum) albicaulis, *Dougl.*; *Gray, Pl. Wright. p.* 74. *adn.* Sides of mountains near El Paso; April. (1380.)

Eucnide bartonioides, *Zucc.*; *Gray, Pl. Lindh.* 2. *p.* 192. On the Rio Blanco, and Guadalupe, Texas.

Cevallia sinuata, *Lagasca.* Stony prairies, on San Felipe Creek, and the Limpio; May, June. (1381.)

PASSIFLORACEÆ.

Passiflora tenuiloba, *Engelm. in Pl. Lindh.* 2. *p.* 192; *Gray, Pl. Wright. p.* 74. Stony prairies, Chicon Creek to the San Pedro. (1083.)

P. affinis, *Engelm. in Pl. Lindh.* 2. *p.* 233. On the Sabinal, Western Texas, July; in fruit.

P. inamœna (sp. nov. § Cieca): herbacea, pilis hamatis hirsuto-pubescens; foliis membranaceis basi cordata trinerviis profunde trifidis, lobis ovali-oblongis subserratis, lateralibus paullo brevioribus plerumque bilobis seu grosse 2 – 3-dentatis; petiolis apicem versus biglandulosis; pedicellis solitariis; bracteolis 2 setaceis; calyce quinquepartito viridulo. — Sides of mountains near Santa Cruz, Sonora; Sept. (1084.) — "Climbing among rocks, one or two feet high." Leaves 2 or 3 inches in diameter, very thin, roughish-pubescent; the terminal lobe narrowed at the base. Stipules lunate, acuminate. Tendrils axillary, simple. Lobes of the calyx about half an inch in length, triangular-lanceolate. Berry ovoid, an inch and a half in length; the stipe not longer than the persistent calyx.

CUCURBITACEÆ.

Melothria pendula, *Linn.*; *Gray, Pl. Wright. p.* 75. On the San Pedro, Western Texas.

Sicydium Lindheimeri, *Gray, Pl. Lindh.* 2. *p.* 194, & *Pl. Wright. p.* 75. On the Rio Frio, Leona, Howard's Creek, and San Pedro, Western Texas; May, June. (1085.) — Berry an inch in diameter.

S. Lindheimeri, var. tenuisectum, *Gray, Pl. Wright. l. c.* Valley of the Pecos, June; and New Mexico between Frontera and the Mimbres, July. (1086.) — The New-Mexican specimens have small leaves, barely an inch in diameter, and compoundly dissected into lobes which are only a line in width. The globose berries are from half to two thirds of an inch in diameter.

Cucurbita perennis, *Gray, Pl. Lindh.* 2. *p.* 193. Along the San Pedro, Western Texas; May. (1087.) — "Certainly monœcious. It exhales an unpleasant smell when bruised."

C. digitata (sp. nov.): radice perenni carnosa; foliis 5-partitis subtus ramisque hispido-scabris supra glabellis secus costas venasque pube brevissima sæpius albo-variegatis, infimis segmentis oblongis sinuato-lobatis, superioribus lobis linearibus elongatis subintegris; calycis lobis fl. fœm. brevissimis, masc. obsoletis; fructu globoso. — Prairies, in loose, sandy soil, between the copper mines, New Mexico, and Conde's Camp; Aug. (1088.) — "Root large, fleshy. Branches prostrate, running from 10 to 20 feet." The segments of the upper leaves are about 3 inches long and 2 to 4 lines wide, either entire, or with one or two laciniate teeth or small lobes towards their base; those of the lower leaves are shorter, about an inch wide, and considerably lobed or incised. Corolla 3 inches long, funnel-form, yellow.

Apodanthera? undulata (sp. nov.): cinereo-hispidula, caulibus e radice carnosa maxima plurimis prostratis; foliis rotundato-reniformibus undulatis denticulatis nunc sublobatis subtus strigoso-canescentibus; floribus pedunculatis luteis, masculis ex axillis infimis racemoso-corymbosis, fœmineis ex superioribus axillis solitariis; tubo calycis maris tubuloso-infundibuliformi; pepone ovoideo. — In valleys from Eagle Springs to the Limpio; June. (1382.) (Carizal, below El Paso, *Wislizenus.*) — Root nearly as thick as a man's leg, penetrating two or three feet in depth, then branching. Stems prostrate, extending from 3 to 8 feet, and with the foliage strigose-cinereous. Leaves 2 to 6 inches in diameter, undulate and somewhat crisped, green above. Staminate flowers all from the lowest axils; the others, however prolonged the stems, bearing solitary pistillate flowers only. Peduncles about the length of the petiole; or the sterile longer than the leaves, bearing several flowers, on pedicels of one or two inches in length. Calyx-tube about an inch long; of the sterile flower narrowly tubular funnel-form; of the fertile oblong-urceolate, and little produced beyond the summit of the ovary; the lobes subulate, 3 lines long. Petals of the sterile flowers oblong, or oval, distinct, inserted by a narrowed base, 9 or 10 lines long; those of the fertile flowers nearly similar. Anthers sessile or nearly so in the throat of the calyx, lightly cohering, at length separate, three in number, two of them bilocular and one unilocular (scil. 5, triadelphous.

of authors), rarely 4, two of them bilocular and two unilocular: connective somewhat dilated; the cells linear, 2½ lines long, straight or nearly so. There is a thickish disk in the bottom of the calyx. Stigma 3-lobed, fleshy. Ovary 3-celled? many-ovuled. The mature fruit, according to Mr. Wright, is ovoid, 3 or 4 inches long, about the size of that of Cucurbita perennis, perhaps of softer consistence than in that plant, but a true pepo. — I cannot hesitate to refer this to the imperfectly known genus Apodanthera of Arnott. I doubt, however, if it be a congener of Apodanthera gracilis, *Benth.*, as it is certainly very different from Melothria.

Cyclanthera dissecta, *Arn. in Hook. Jour. Bot.* 3. *p.* 280; *Gray, Pl. Wright. p.* 75. Guadalupe Pass, between Santa Cruz, Sonora, and the copper mines, New Mexico; Oct., with ripe fruit. (1089.) — The mature fruit is dry, with thin walls, somewhat compressed, semiovate, one margin strongly gibbous, the other straight or slightly concave, pointed (the point a little recurved), an inch long, beset with soft and naked prickles; within, near the concave or inner edge, hangs from the summit an elongated placenta, which reaches nearly to the base of the single cell; here, on short and persistent 2-ranked funiculi, are attached 6 or 7 ascending seeds, partly covered by the fibrous remains of the tissue of a sparing pulp. The seeds are 3 lines long, compressed, pointed at the hilum, nearly truncate at the opposite end; the testa brown, firm, tuberculate-roughened. Whether the ovary is more than one-celled I cannot clearly ascertain. If there are any partitions, they speedily disappear.

Elaterium? Wrightii (sp. nov.): caule pubescente; foliis reniformi-cordatis subangulatis apice triangulato-acuminatis puberulis margine vix denticulatis; cirrhis trifidis; floribus masculis racemosis, calyce brevissimo subplano, fœmineis solitariis collo filiformi; petalis ovalibus acutiusculis; ovario biloculari, loculis singulis 3-ovulatis; fructu oblongo recto aculeis longis mollibus hirsutis armato apice rostrato-apiculato. — Mountains at Guadalupe Pass, with the preceding; Oct. (1090.) Organ Mountains, near El Paso; May. — "Climbing, 4–6 feet high." This is evidently a congener of Elaterium pubescens, *Benth.*, and of other Mexican plants referred to this genus. The leaves are much like those of E. pubescens, and the inflorescence is similar; but the male flowers are several times smaller (only 3 lines in diameter) and on shorter pedicels, and the calyx is as flat as that of a Sicyos. I should have referred it to E. hastatum, *H. B. K.*, except that the male flowers can hardly be called minute; and the fruit is not reniform; nor is it 2-valved, but dehiscent at the apex. The fruit is from 12 to 18 lines long, the slender prickles half an inch long. The dissepiment remains, either complete or incomplete, at maturity. Seeds 2 or 3 in each cell, flattish, truncate at the apex, tuberculate, nearly 3 lines long. — The petals are sprinkled with adherent pollen-grains as in E. pubescens, in which they were described as "punctate."

E.? Coulteri (sp. nov.): parce scabro-pubescens; foliis rotundo-cordatis profunde 5-lobis, lobis ovatis dentatis acutis, terminali acuminato; cirrhis trifidis; floribus masculis racemosis, calyce brevissimo patente, fœmineis solitariis collo filiformi; petalis oblongis retusis; fructu fere præcedentis. — (Zacatecas, Mexico, *Coulter*, No. 51.) Hills along the Coppermine Creek, New Mexico; Aug. — The few specimens are in flower only; but it appears to be the same as one I possess

from Coulter's Mexican collection, which exhibits the fruit. The corolla is twice the size of that of E. Wrightii. The leaves are one to two inches in diameter. — Sicyos eremocarpus, *Schauer in Linnæa*, 20. *p.* 722, is probably a congener of this, and possibly the same species; but it is said to have the lobes of the leaves entire or nearly so, the tendrils simple, and the fruit glabrous. The surface of the fruit and the prickles in ours are sparsely hirsute.

Sicyos parviflorus, *Willd. Spec.* 4. *p.* 626; *H. B. K. Nov. Gen. & Spec.* 2. *p.* 119. Stony hills, near the copper mines, New Mexico, Aug.; and in a rocky cañon towards the Guadalupe Pass, Oct. (1091.) — This is the same as No. 50 of Coulter's Mexican collection, from Real del Monte. The branches and the leaves are usually scabrous-pubescent; and the ripe fruit, which is only three lines long, is ovoid, obtuse, and not crowned with the remains of the calyx. The retrorsely barbed prickles are at length partly deciduous from the mature pericarp, which is closely conformed to the oval seed. The leaves are rugosely veined, rounded in outline, and very unlike those of S. angulatus. Instead of the rank smell of that species, the foliage, in cultivated specimens, exhales a rather pleasant odor in drying.

SICYOSPERMA, *Nov. Gen.*

Flores monoici. *Masc.* Calyx late campanulatus, subulato-5-dentatus. Corolla calyci adnatim inserta, limbo 5-partito, lobis apice bicuspidatis. Stamina 5, in columnam apice capitato-antheriferam connata, imo calyce inserta: antheræ ovales, uniloculares, parallelæ, adnatæ. *Fœm.* Calycis tubo supra ovarium constricto, limbo planiusculo 5-dentato. Corolla maris, nisi lobis integris muticis. Ovarium uniloculare, ovulo unico pendulo. Stylus brevis: stigma peltatum trilobum. Fructus utriculiformis, ovatus, lenticularis, pericarpio membranaceo lævi semini arcte conformi. Testa crustacea, lævis. Cotyledones carnosæ, orbiculares, plano-convexæ. — Herba annua, scandens, cirrhosæ; foliis cordato-rotundis angulatis vel sublobatis; floribus minimis albidis, masculis in racemo brevi sæpe trifido, fœmineis in eadem axilla solitariis, primariis breviter pedunculatis nudis, secundariis (ex ramo axillari prolifero androgyno) subsessilibus bractea foliacea tripartita inclusis.

Sicyosperma gracile. — Mountain ravine at Santa Cruz, Sonora; Sept. (1092.) — Stems 2 to 5 feet long, slender, glabrous, or slightly scabrous-hispid, like the petioles. Leaves from three fourths of an inch to three inches in diameter, somewhat pubescent and scabrous, denticulated, angled or obscurely 5-lobed, the terminal lobe conspicuously mucronate. Tendrils mostly 2-cleft. Sterile racemes shorter than the petiole; those of the proliferous branches of the inflorescence shorter than the 3-parted and crenate-toothed bract, which subtends and loosely incloses the accompanying fertile flower. Corolla barely a line or a line and a half in diameter; the lobes ovate; those of the sterile flowers tipped with two conspicuous cuspidate points; which are wanting in the fertile flowers. Ovary at first pubescent with sparse and lax hairs, containing a single ovule suspended from the summit of the cell. Fruit 2 lines long, ovate-lenticular, smooth, green, turning brown or blackish when fully mature, and appearing like a seed: the thin and membranaceous pericarp closely investing the turgid-lenticular and smooth seed. — The character

of this singular new genus, of the tribe Sicyoideæ, is drawn both from the dried specimens and from living plants raised from their seeds in the Cambridge Botanic Garden.

GROSSULACEÆ.

Ribes tenuiflorum, *Lindl. Bot. Reg. t.* 1274? Banks of the San Pedro, Sonora, Sept.; in fruit only. Cimieluque Springs, Chihuahua, April; in flower and fruit. (1093.)

R. leptanthum, *Gray, Pl. Fendl. p.* 53. Sides of mountains at the copper mines, New Mexico; Aug. (1094.) — "Stems 3 to 5 feet high." Leaves mostly larger and less fascicled than in Fendler's specimens.

FOUQUIERIACEÆ.

Fouquiera splendens, *Engelm. in Wisliz. Mem. N. Mex. p.* 98; *Gray, Pl. Wright. p.* 76. Rocky hills of the San Pedro, Western Texas, May; in fruit. Hills around El Paso, May; in flower. — Mr. Wright has called my attention to a singular structure of the leaves in this plant, which is well shown in the growing shoots of some of the specimens; namely, that the spines are the persistent petioles of the cauline leaves, or rather a dorsal portion of them, to which a long and slender downward prolongation of the blade of the leaf is adnate for its whole length, and from which it separates, when full-grown, from the apex to the base. The foliaceous portion soon falls away, leaving the long and naked spine, from the axil of which a cluster of subsessile secondary leaves is developed. The spine itself is decurrent on the stem into an elongated *pulvinus* or ridge, which extends downward quite to the next axil directly underneath.*

CRASSULACEÆ.

Sedum Wrightii, *Gray, Pl. Wright. p.* 76. Crevices of rocks at the copper mines, New Mexico; and at Santa Cruz, Sonora; Sept., Oct. (1095.)

SAXIFRAGACEÆ.

Heuchera sanguinea, *Engelm. in Wisliz. Mem. N. Mex. p.* 107. In ravines, at Santa Cruz, Sonora; Sept. (1096.) — "Certainly the most ornamental species of the genus." The flowers are deep red, 4 or 5 lines long, crowded in a simple or occasionally branched thyrsus of an inch or two in length. As in other species, the scape is sometimes perfectly naked, and sometimes furnished with small leaves.

H. rubescens (*Torr. in Stansb. Rep. p.* 388. *t.* 5): glabella; scapo subfoliato vel nudo; foliis cordato-rotundis sublobatis inciso dentatis ciliatis, dentibus brevibus setiferis; panicula laxa multiflora; floribus virido-albis mox rubellis;

* Fouquiera formosa, *H. B. K.* has recently (in *Kongel. Danske Vidensk. Selk. Skrifter*, for 1851) been characterized and figured by Liebmann as a new and anomalous genus of Polemoniaceæ, named *Piletæria horrida.* From the details of the seeds, it appears that the wing differs from that of F. splendens in being deeply cleft at both ends. — Kunth writes the name *Fouquieria;* but De Candolle, Endlicher, &c. write it *Fouquiera.*

calyce cylindraceo-campanulato, tubo turbinato, lobis oblongis æqualibus; petalis unguiculatis lineari-spathulatis cum staminibus stylisque breviter exsertis. — Crevices of rocks, on mountains near the copper mines, New Mexico; Aug. (a large form, the scapes with the compound panicle one to two feet long), and Oct. (a small form like the specimens gathered in Utah by Capt. Stansbury, the scapes with the more simple panicle a span to a foot high). (1097.) — Petioles either beset with spreading hairs, or naked, as are the scapes. Leaves one to nearly two inches wide; the lobes and teeth short and broad. Scape either leafless or with a few small and sharply toothed or cleft leaves. Pedicels 2 or 3 lines long, minutely granulose-glandular, like the calyx-tube and rhachis, longer than the linear or subulate bracts. Calyx 2 or 3 lines long, at first whitish with the lobes tipped with green, soon turning rose-red or purple. Bracts and pedicels often purplish.

H. RUBESCENS, *Torr.;* var. nana; scapo subspithamæo; floribus parvulis. — With the preceding; Aug. — A few specimens were gathered of this plant, apparently only a dwarfed state of H. rubescens, with the flowers much smaller, but scarcely developed. I suspect it is the same as the Tiarella ? bracteata of Torrey, in James's Rocky Mountain collection, and therefore Heuchera bracteata, *Seringe in DC. Prodr.* If it truly prove to be only a depauperate form of H. rubescens, the anterior name ought to give way, on account of its manifest inapplicability.

H. PARVIFOLIA, *Nutt. in Torr. & Gray, Fl.* 1. *p.* 581; *Gray, Pl. Fendl. p.* 54; var. floribus majoribus magis campanulatis. — Mountain-sides near the copper mines, New Mexico. (1098.) — A form with more campanulate flowers, as large as those of H. Americana. The plant connects the section Heucherella with Holochloa.

FENDLERA RUPICOLA, *Engelm. & Gray, Pl. Wright. p.* 77. *t.* 5. Rocky banks of the San Pedro, Western Texas, May; in fruit. Mountains near El Paso, April; in flower. (1049.) — The petals are puberulent externally (like the inside of the calyx-lobes); they are imbricated in æstivation! — Specimens recently communicated by Lindheimer, in full flower, have their virgate branches loaded with the white blossoms, showing that the plant would be very ornamental in cultivation.

PHILADELPHUS SERPYLLIFOLIUS, *Gray, Pl. Wright. p.* 77. Summit of mountains, at Wild Rose Pass, head of the Limpio; June. (1100.) — Shrub 2–5 feet high, much branched.

P. SERPYLLIFOLIUS, var. foliis floribusque majoribus. — Mountain-sides at the copper mines, New Mexico; Aug. (1101.) — The leaves on the more vigorous branches are from half an inch to even an inch in length, and the expanded flowers almost an inch in diameter; but there is no other apparent difference.

UMBELLIFERÆ.

HYDROCOTYLE RANUNCULOIDES, *Linn. f.* Margin of a creek at Santa Cruz, Sonora; Sept. (1102.)

H. INTERRUPTA, *Muhl.* Comanche Spring, Western Texas; June. (1383.) — The California plant referred here is different.

BOWLESIA TENERA, *Spreng.* was found by Mr. Wright in the streets of San Antonio, Texas; doubtless introduced.

Eryngium longifolium, *Cav. Ic.* 6. *t.* 555; *DC. Prodr.* 4. *p.* 95? Las Playas Springs, near the Sierra de los Animos, New Mexico; Oct. (1103.) — The radical leaves are 3 or 4 feet long, 4 or 5 lines wide, tapering to a point, soft, resembling those of a large Sparganium; their margins entire and naked, or rarely with one or two setiform teeth; these sparingly appear on the similar but shorter cauline leaves. The scales of the involucre are much shorter than the oval heads, linear-subulate, often resembling the paleæ and scarcely exceeding them.

E. Leavenworthii, *Torr. & Gray, Fl.* 1. *p.* 604. Zoquete Creek, Western Texas; July.

E. Wrightii, *Gray, Pl. Wright. p.* 78. Pebbly bed of the Limpio; June; also mountain valleys in Sonora, Sept. (1104.)

Berula angustifolia, *Koch, Fl. Germ. & Helv. ed.* 2. 1. *p.* 317? *Gray, Pl. Fendl. p.* 55. Helosciadium? Californicum, *Hook. & Arn. Bot. Beech. p.* 142? Sium pusillum, *Nutt.?* Margin of the Mimbres, New Mexico, July; and of the Barbocomori, Sonora, Sept. Between the Leona and Comanche Springs. (1105.) Also found by Lindheimer in Western Texas. — The leaflets vary on the same plant, from oblong and barely serrate, to deeply pinnatifid with linear and often incised segments. I cannot clearly distinguish it from the European plant; although it is likely to be different.

Leptocaulis patens, *Nutt.* Hills of the San Pedro and the Pecos; May. (1106.)

L. echinatus, *Nutt.* Dry soil near El Paso, and at Lake Santa Maria; April. (1384.)

Cicuta maculata, *Linn.* Springs on the Pecos; June.

Daucosma laciniatum, *Engelm. & Gray, Pl. Lindh.* 2. *p.* 210. Pebbly bed of Pedregal Creek, Western Texas; July. (1385.)

Thaspium? montanum, *Gray, Pl. Fendl. p.* 57; var.? tenuifolium. Hill-sides of Coppermine Creek, New Mexico; Aug. (1107.) — The specimens accord with the slender-leaved form of Fendler's No. 276, except that they are larger, a foot or more in height. The thick root is inodorous. The segment and lobes of the leaves are all narrowly linear, from 6 to 18 lines long. Umbel on a long peduncle, dense; the primary and secondary rays short. Fruit 2 to 3 lines long, tasteless; the mericarps flattened as much as in most Angeliceæ, oval, each with rather wide marginal wings, the three dorsal ribs extended into sharp and strong ridges, or one or two of them into wings of variable size, occasionally as wide as the marginal ones. Vittæ single and large, or usually double, in each interval.

Daucus pusillus, *Michx.* γ. scaber, *Torr. & Gray, Fl.* 1. *p.* 636. D. scaber, *Nutt.* Mountains near Lake Santa Maria, Chihuahua; April. (1386.)

Atrema Americana, *Nutt.* Prairies of the Leona and Nueces, May. (1108.)

ARALIACEÆ.

Aralia humilis, *Cav. Ic.* 4. *p.* 7. *t.* 313. A. pubescens, *DC.*? Mountain ravine, in crevices of rocks, at Santa Cruz, Sonora; Sept. (1109.) — "Stem 2 to 4 feet high," suffruticose, smooth. Leaflets membranaceous, 2 or 3 inches long, minutely pubescent, at length glabrate, ovate or oblong-ovate and acuminate, some of them

cordate, others obtuse or acute at the base. I suspect, therefore, that A. humilis, *Cav.* and A. pubescens, *DC.* are not distinct, if the present plant really belongs to either of them.

CAPRIFOLIACEÆ.

Sambucus glauca, *Nutt. in Torr. & Gray, Fl. 2. p.* 13; var. foliolis anguste lanceolatis. — Among rocks, on mountains near the copper mines, New Mexico, Oct.; in fruit. (1110.) — "Stems 6 to 10 feet high." Leaflets 5, or the uppermost 3 (wrongly said to be 3–5-pairs in the *Flora* above cited), about 3 inches long, 6 to 8 lines wide. Berries glaucous. To this probably belongs Fendler's No. 286, which was erroneously referred to S. pubens.

S. Mexicana, *Presl in DC. Prodr.* 4. *p.* 323. Around houses at San Elizario on the Rio Grande, June; in flower. (1387.) — "Trunk 8 to 12 feet high, 6 inches or more in diameter." The leaflets vary from 5, or even 3, to 7. Hartweg's No. 1756 belongs apparently to the same species.

Symphoricarpus rotundifolius (sp. nov.): foliis orbiculatis seu ovato-rotundis parvulis ramulisque molliter pubescentibus; floribus axillaribus solitariis; bracteolis ovario brevioribus dentibusque calycis cyathiformis ovatis obtusis glabris; corolla infundibuliformi intus glabra, lobis stamina superantibus. — Sides of mountains around the copper mines, New Mexico; Aug. (1388.) — Stems 3 or 4 feet high, much branched. Leaves 5 to 9 lines long and 4 to 9 wide, softly and finely pubescent above, and finely tomentose underneath, entire, or the larger often repand; the petiole a line or less in length. Flowers almost sessile in the axils of the upper leaves. Calyx with the ovary a line and a half long, its lobes slightly if at all ciliate. Corolla 3 lines long, tubular-funnelform. Fruit not seen. — The leaves are rounded and more downy than in Nuttall's S. mollis, and the inflorescence as well as the shape of the corolla is entirely different. The flowers are more like those of S. glaucescens and S. montanus, but only half as large; and they, as well as the leaves, are larger than in S. microphyllus (as described by Kunth), with which in other particulars its characters do not accord.

Lonicera (Caprifolium) dumosa (sp. nov.): foliis ovalibus basi acutis sessilibus subcoriaceis subtus pallidis utrinque cum ramulis confertis crebre piloso-pubescentibus, floralibus in discum ellipticum connato-confluentibus; capitulo simplici arcte sessili; ovario glaberrimo; calycis limbo truncato hirsuto. — Banks of a torrent between Rock Creek and the Limpio, June; in fruit. (1389.) — A much-branched, slightly twining shrub, 3–5 feet high. Leaves 10 to 18 lines long, mostly obtuse, clothed with a soft spreading pubescence, especially underneath; only the uppermost pair connate-perfoliate. Berries globose, 2 lines or more in diameter. Pubescence not at all glandular or viscid. — Although the corolla is unknown, I do not hesitate to characterize this as a new species.

RUBIACEÆ.

Galium microphyllum, *Gray, Pl. Wright. p.* 80. Bed of the Limpio, June; also in ravines and on stony hills, on the Organ Mountains, and at the copper mines,

New Mexico; and near Santa Cruz, Sonora. (1111.) — Leaves in some forms larger than in Wright's No. 234.

G. PROLIFERUM (sp. nov.): annuum, hispidulum; caule tenero suberecto debili; foliis quaternatis oblongis internodiis multoties brevioribus; pedunculis axillaribus gracilibus apice florem unicum deflexum inter bracteas 2 foliiformes subsessilem gerentibus nunc sæpe proliferis 2–3-floris nunc quadrifoliatis furcatis atque in ramulum floridum extensis; corolla minima albida; fructu setis longis apice uncinatis hispidissimo. — G. virgatum, var. diffusum, *Gray, Pl. Wright. p.* 80. — High, rocky hills of the Pecos; June, 1851. Stony hills on the Rio Grande, near San Elizario and El Paso; March, April. (1112.) — Stems slender, at first simple and 3 to 5 inches high, bearing one or two slender and spreading peduncles, or simple flower-branches of 4 to 10 lines in length, from each whorl; these are terminated by a pair of leaf-like bracts subtending a deflexed flower, in the manner of G. virgatum (only that has the peduncle extremely short); many of them are proliferous, especially as the plant grows larger, and produce 2, 3, or even 4 flowers one above the other in the same manner; or some bear a whorl of leaves, and are extended into an ordinary branch. The main stem soon branches from the base, attains 6 to 10 inches in length, and becomes diffuse. The bristles of the fruit are longer than in G. virgatum, their length equalling the diameter of the cocci.

G. WRIGHTII, *Gray, l. c.* Crevices of rocks in ravines, at Santa Cruz, Sonora, growing in dense branches; Sept. (1113.)

G. ——— Too young to determine. On the Limpio, with No. 1111.

G. ASPERRIMUM, *Gray, Pl. Fendl. p.* 60. Mountains, east of Santa Cruz, Sonora; Sept. (1114.)

G. TRIFIDUM, fere γ. LATIFOLIUM, *Torr. & Gray, Fl. 2. p.* 22. In springs, near the Sierra de los Animos, New Mexico; Oct. (1115.) — "Stems 2 to 3 feet high, supported by club-rushes."

BOUVARDIA HIRTELLA, *H. B. K.*; *Gray, Pl. Wright. p.* 80. Wild Rose Pass, on the Limpio, and on Rock Creek; June. (1116.)

B. JACQUINI, *H. B. K. l. c.*, var. ovata, *DC. Prodr.* 4. *p.* 365? Mountain ravine at Santa Cruz, Sonora; Sept. — "A foot high. Flowers scarlet."

B. OVATA (sp. nov.): herbacea? glabra; foliis quaternis ternisve ovatis utrinque acutis subpetiolatis penninerviis; stipulis setaceis; cyma multiflora; calycis lobis subulatis tubo subduplo longioribus tubo corollæ intus pilosulo sextuplo brevioribus. — Mountain valley from San Pedro to Santa Cruz, Sonora; Sept. (1117.) — Stems a foot or more high, the base not seen, but probably herbaceous, simple, leafy to the top. Leaves about the length of the internodes, $1\frac{1}{4}$ to $2\frac{1}{2}$ inches long, an inch or more in width, the margins, as also the lobes of the calyx, minutely ciliolate. Corolla an inch long, apparently purple, the lobes short, ovate, and obtuse.

OLDENLANDIA (ERCICOTIS) ACEROSA. Hedyotis (Ercicotis acerosa), *Gray, Pl. Wright. p.* 81. Limestone prairies, Turkey Creek, Texas, and westward; May. (1118.) — Mr. Bentham, in *Kew Jour. Bot.* 4. *p.* 172, has pointed out the difference between "Hedyotis, with its fruit splitting into two cocci," and "Oldenlandia,

Anotis, and Houstonia, with their purely loculicidal dehiscence," constituting "a natural genus, which is the Hedyotis of Torrey and Gray's Flora." Moreover, the name Oldenlandia should have been preferred by the botanists who combined the whole into one genus, inasmuch as it has forty-four years' priority over Hedyotis, and ten over Houstonia; and Bentham has rightly restored it for the present genus.

O. (Houstonia) rubra. Hedyotis rubra, *Gray, Pl. Fendl. p.* 61. Stony hills, from Santa Barbara to the copper mines, New Mexico; July. (1119.)

O. (Houstonia) humifusa. Hedyotis humifusa, *Gray, Pl. Lindh. 2. p.* 216, *& Pl. Wright. p.* 82. On the Limpio; June.

O. angustifolia (Houstonia angustifolia, *Michx.*), var. = Hedyotis stenophylla, var. parviflora, etc., *Gray, Pl. Wright. p.* 81. Rocky hills, near Eagle Springs; June. (1390.)*

Mitracarpium breviflorum (sp. nov.): annuum, glabriusculum; caule erecto subtetragono; foliis lanceolatis utrinque acutis sessilibus; stipulis parce hispidis; calycis laciniis 2 majoribus lanceolato-subulatis corolla subduplo longioribus, 2 hyalinis multo minoribus. — Mountain ravines and hill-sides, near Santa Cruz, Sonora; Sept. (1120.) — Stems 2 to 6 inches high. Leaves about an inch long, $1\frac{1}{2}$ to 3 lines wide, usually four subtending the terminal capitulum. Bracts hyaline, setaceous, glabrous. Calyx almost glabrous; the two large teeth canalicu late, soon recurved-spreading, rigid, a line and a half long; the two small ones resembling interposed stipules, usually considerably shorter than the tubular-funnelform corolla, which is white, glabrous, and seldom a line in length. Dehiscence and seeds as in M. Schizangium. — The shortness of the corolla and the shape of the leaves appear to distinguish this from Bentham's M. lineare.

Crusea Wrightii (sp. nov.): annua; caule subreverse hirsutulo tereti; foliis lanceolatis acutis hirtello-scabris nervis utrinque 3 – 4, floralibus 4 – 8 capitulum laxiflorum terminale involucrantibus basi dilatatis et hispido-ciliatis; calycis laciniis subulatis corollæ purpureæ tubum subæquantibus. Prairies, near Santa Cruz, Sonora; Sept. (1121.) — Stems 3 to 10 inches high, slender, terete, not in the least angled, sparingly branched. Primordial leaves subrotund, small; the others lanceolate or linear-lanceolate, 12 to 20 lines long and 2 or 3 broad, narrowed at the

* The following species was discovered in Texas several years since by Mr. Wright; but I have not until now received sufficient specimens to characterize it.

Oldenlandia subviscosa (*Wright. in herb.*): annua, minutim viscoso-hirtella; caule tenello ramoso; ramis divaricatis; foliis linearibus imisve sublanceolatis acutis basi attenuatis; floribus terminalibus nunc alaribus et pseudo-lateralibus solitariis pedunculo æquilongis; corolla minima (albida) hypocraterimorpha, tubo calycem viscoso-hirtellum 4-fidum adæquante lobis obovatis longiore; capsula didyma ad apicem liberum transversim loculicida. — Between La Grange and Lockhart Springs, Fayette County, Texas, in sandy post-oak woods; May. — Plant 3 to 5 inches high, slender, divaricately branched, with a flower in each fork. Leaves half an inch long, half a line, or the lowest a line, in width, sessile, mostly shorter than the internodes. Stipules triangular or ovate, minute, scarious. Pedicels slender, $1\frac{1}{2}$ to 2 lines long, often recurved or spreading in fruit. Lobes of the deeply 4-cleft calyx lanceolate-subulate, in fruit as long as the tube. Corolla a line or a line and a half in length; the limb 4-lobed. Capsule membranaceous, subglobose, didymous, a line and a half in length, somewhat greater in width, loculicidal across the top, which alone is free from the calyx; the cells 10-seeded. Seeds meniscoid, smooth.

base, except the floral ones. Stipular sheaths bearing 5 to 7 setæ on each side; these are beset, especially those of the upper and floral leaves, with strong bristles. Head rather few-flowered. Bracteal stipular setæ strongly setose with long hispid hairs. Ovary didymous, nearly glabrous. Lobes of the calyx four, equal (or sometimes two of them very short), and with as many small interposed teeth, hispid-ciliate towards the base. Corolla slender, only two lines long. Mature fruit not seen.

Diodia teres, *Watt.; Torr. & Gray;* var.? parvula; caule subsimplici erecti-usculo; foliis anguste lincaribus acutissimis. — Mountain valleys between the San Pedro and Santa Cruz, Sonora; Sept. (1122.) — The specimens are small, from 2 to 6 inches high, from an annual root, nearly erect, and resemble the narrowest-leaved forms from New Jersey, rather than the plant of the Southern States.

COMPOSITÆ.

Vernonia Jamesii, *Torr. & Gray, Fl.* 2. *p.* 58. Valley of the Limpio and Rain-water Creek; June. — The form with smaller heads. (1391.)

V. Lindheimeri, *Gray & Engelm. Pl. Lindh.* 2. *p.* 217. Pebbly bed of the San Pedro, Western Texas; July. (1392.)

Pectis prostrata, *Cav.; Gray, Pl. Wright. p.* 83. Rocky hills, between the copper mines and Conde's Camp, New Mexico, Aug.; and near Santa Cruz, Sonora, Sept. A dwarf variety, like Wright's No. 245. (1123.)

P. (Pectidopsis) angustifolia, *Torr.; Gray, Pl. Fendl. p.* 61, *& Pl. Wright. l. c.* Stony hills near the copper mines, New Mexico; Aug. (1124.) — The original form of the species, without any awns to the pappus.

P. (Pectidopsis) filipes, *Harv. & Gray, Pl. Fendl. p.* 62. Stony hills of Copper-mine Creek, New Mexico; Aug. (1125.) — A low, divergently much-branched plant, with the capillary peduncles from 12 to 18 lines long: exactly like No. 329 of Coulter's Californian Collection, except that the pappus of the disk-flowers is commonly one-awned. P. uniaristata, *DC.* is described as having mucronate-aristate leaves, and the scales of the involucre acuminate.

P. (Pectothrix) papposa, *Harv. & Gray, l. c.* Sandy soil, at Doña Ana, New Mexico; July. (1126.) — "Divaricately much-branched from the root, procumbent." I have raised this from seed in the Cambridge Botanic Garden. Its prostrate, divergently-branched stems extend to a foot in length; its leaves are often 2 inches or more in length, barely a line wide, rather fleshy; the peduncles about an inch long. Involucre 3 lines long; the golden-yellow ligules (8) about the same length. The pappus of the ray is very short, somewhat auriculate or coroniform, sometimes nearly obsolete. — In a single wild specimen, intermixed with the others, the pappus is reduced to setæ very much shorter than the tube of the corolla, and more or less coroniform-concreted; otherwise it is undistinguishable from the rest of the specimens.

P. (Pectothrix) longipes (sp. nov.): herbacea, glabra; caulibus brevibus ramosissimis decumbentibus; foliis lincaribus mucronatis secus margines grosse glandulosis basi ciliis utrinque 1 – 3 instructis; pedunculis prælongis; involucri multiflori squamis 12 – 13 uniglandulosis; pappo radii biaristato, disci multisetoso.

— Mountain valleys, between the San Pedro and Santa Cruz, Sonora; Sept. (1127.) — Stems 1 to 3 inches long, in the cultivated plant longer and more procumbent, slender. Leaves 12 to 18 lines long, 1½ to 2 lines wide, rather fleshy. Peduncles 4 to 6 inches long, the earliest scapiform, naked or with a few minute bractlets. Scales of the campanulate involucre 3 lines long, linear, rather obtuse, bearing usually only a single gland. Ligules 12 or 13, oblong. Disk-flowers 40 or more. Achenia puberulent. Pappus in the ray of two slender awns or stout bristles, as long as the tube of the ligule, not scarious-dilated at the base, minutely scabrous; in the disk of 30 or 40 capillary and very unequal scabrous bristles; the longer ones little shorter than the corolla.

P. IMBERBIS (sp. nov.): glaberrima, ultrapedalis; caulibus e radice perenni plurimis erectis gracilibus rigidis angulatis apice paniculato-cymosis polycephalis; foliis anguste linearibus secus margines parce nigro-glandulosis haud setigeris; capitulis pedicellatis; involucri squamis 5 linearibus obtusis glandulis nigris oblongis linearibusve parce notatis; ligulis 5 oblongis; fl. disci 5 – 7; acheniis hirtellis; pappo conformi e paleis 2 – 5 inæqualibus sæpius dimidiato. — On the Sonoita, near Deserted Rancho, Sonora; Sept. (1399.) — This singular species, with the characters otherwise of a genuine Pectis, is remarkable for the total absence of cilia fringing the base of the leaves, as well as for its size; the stems being a foot or more in height. The root is rather ligneous. The leaves are 1½ to 2 inches long, only a line wide, and perfectly entire. Peduncles an inch or less in length, sparingly and minutely bracteolate. Involucre 4 lines long; the scales conduplicate around the ray-achenia. Ligules 3 lines long, yellow, changing, as do also the disk-flowers, to red or purple. Disk-corollas slightly bilabiate, the teeth each dotted with a dark gland. Pappus nearly alike in the disk and ray, mostly of about 5 lanceolate paleæ, three of which are minute, and two half the length of the disk-corolla, or in the central achenia all small and nearly equal; in the exterior achenia more or less unilateral.

TRICHOCORONIS RIVULARIS, *Gray, Pl. Fendl. p.* 66. In Piedra Pinta Creek, Western Texas; May. (1128.)

CŒLESTINA AGERATOIDES, *H. B. K.; DC. Prodr.* 5. *p.* 108. Crevices of rocks, Guadalupe Pass, between the San Pedro, Sonora, and the copper mines; Oct. (1129.)

STEVIA MACELLA (sp. nov.): annua, subpedalis, viscoso-pubens; foliis tenuimembranaceis glabellis ovatis grosse dentatis triplinerviis basi acutis in petiolum marginatum decurrentibus, superioribus alternis; capitulis paniculatis breviter pedicellatis; involucri squamis acutis; pappo paleaceo brevissimo subcoroniformi floris unici exaristato cæt. aristis 3 corolla sublongioribus. — On shaded rocky cliffs of Coppermine Creek, New Mexico; Oct. (1130.) — Stem slender, erect, with short paniculate flowering branches. Leaves very thin and membranaceous, about an inch and a half long, and an inch wide, all more or less cuneate at the base, on slender margined petioles; the lower only opposite. Heads rather numerous in terminal and lateral short corymbose panicles, longer than the pedicels. Involucre 3 lines long, viscous-pubescent. Corolla 2 lines long, whitish. Awns of the pap-

pus denticulate, purplish. Achenia with the pappus 4½ lines long. — This needs to be compared with S. micrantha, *Lagasca*, which is said to have subcordate leaves and very small flowers.

S. CANESCENS, *H. B. K.*? *Benth. Pl. Hartw.*; var. glabriuscula; capitulis paullo longioribus; aristis pappi sæpius 4 – 5. — Hill-sides, near Santa Cruz, Sonora; and on mountains near the copper mines, New Mexico; Sept., Oct. (1131.) — This appears to be the same as Hartweg's No. 136, although the stem is less hirsute, and the heads rather longer and looser. To neither is the specific name at all applicable, and very probably it is not the plant described by Kunth. In both the awns are frequently 4, or in ours 5, in number; and one of the flowers is occasionally awnless. The corolla is white or whitish.

CARPHOCHÆTE BIGELOVII (*Gray, Pl. Wright. p.* 89, *adnot.*): fruticulosa, subpuberula; caulibus foliosis ramosis; foliis brevibus linearibus oblongisve, inferioribus spathulato-oblongis trinervatis; capitulis solitariis 2 – 3-nisve in ramis brevibus conferte foliosis sessilibus; squamis involucri cuspidato-acuminatis resinoso-punctatis; pappi paleis 11 – 14 aristatis cum squamellis 1 – 3 parvis lanceolatis muticis obsolete uninerviis. — (Near the copper mines, New Mexico, *Dr. J. M. Bigelow.*) Hill-sides in the Organ Mountains, northeast of El Paso; April. (1393.) — Stems numerous from a ligneous root, tufted, a span to a foot high, often fasciculately branched, leafy to the top. Leaves mostly fascicled in the axils and crowded on the short flowering branches; the lowest an inch long and 4 or 5 lines wide, very obtuse, manifestly 3-nerved; the upper narrower, and varying from linear-oblong to linear; those of the fascicles and flowering branches 3 to 6 lines long and 1 to 2 wide, mucronate-acute, usually crowded about the base of the sessile heads, which are fully an inch in length. "Limb of the corolla white; the tube purple." — From the fine specimens gathered last spring by Mr. Wright along with Dr. Bigelow, I am now enabled to complete the account of this well-marked species, which I before imperfectly characterized from a fragment received in a letter. It differs remarkably from the other species in its fasciculate habit and sessile heads.

KUHNIA EUPATORIOIDES, var. (= 247, *Pl. Wright. p.* 83). Zoquete Creek, Western Texas; May. (1132.)

K. EUPATORIOIDES, var. verging to δ. gracillima. Stony hills at the copper mines, New Mexico, Aug.; and from the pass of the Chiricahui Mountains to Santa Cruz, Sonora, Sept. (1133.) Also between Comanche Spring, Texas, and the Pecos; June. (1394.)

CARMINATIA TENUIFLORA, *DC. Prodr.* 7. *p.* 267; *Deless. Ic. Sel.* 4. *t.* 99. Among rocks, at the copper mines, New Mexico; and on the Sonoita, near Deserted Rancho, Sonora; Sept., Oct. (1134.) — I have raised this from seed in the Cambridge Botanic Garden. The young stems are sparingly hairy.

BRICKELLIA OLIGANTHES, *Gray, Pl. Wright. p.* 84; var. magis cinerea vel canescens; foliis plerisque linearibus. — Crevices of rocks, in a mountain ravine at Santa Cruz, Sonora; Sept. (1135.)

B. WISLIZENI, *Gray, Pl. Fendl. p.* 64, & *Pl. Wright. l. c.*; var. foliis majoribus (3-pollicaribus); ramis axillaribus floriferis 3 – 5-cephalis. — Sides of mountains,

near Santa Cruz, Sonora; Sept. (1136.) — This, if I rightly remember, will nearly accord with a plant gathered by Seemann, at Cerro de Pinal.

B. BETONICÆFOLIA (sp. nov.): herbacea, pilis multiarticulatis patentibus hirsuta; caulibus virgatis simplicibus; foliis omnibus oppositis breviter petiolatis cordato-oblongis obtusis grosse crenatis scabro-hirtellis triplinerviis subtus rugoso-reticulatis, floralibus decrescentibus nunc parvis subsessilibus; capitulis pedicellatis in thyrsum terminalem racemosum elongatum laxum superne nudum digestis; pedunculis singulis 2–5-cephalis; involucro 12-floro laxo, squamis 2–3-serialibus lanceolatis et linearibus acuminatis, extimis brevibus ciliatis; acheniis sericeo-villosis; pappo scabro. — Hills, near the copper mines, New Mexico; Oct. (1137.) — Stems several from the same perennial root, 2–3 feet high, roughish-hirsute, or nearly hispid, terminating in a raceme-like, loose and interrupted, nearly leafless, virgate thyrsus, of a foot or more in length. Leaves as long as the internodes, rather rigid, but not coriaceous, very veiny underneath with coarse reticulations, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, all more or less cordate at the base; the petioles distinct, but only a line and a half in length. Peduncles and pedicels 3 to 9 lines long, hirsute and somewhat glandular. Heads 5 or 6 lines long; the involucre and the pappus nearly as in B. Wislizeni. — This species should stand next to B. cylindracea and B. Wislizeni, to which it is more closely related than to any of the section which contains B. Cavanillesii, notwithstanding the cordate leaves.

B. BETONICÆFOLIA, var. humilis; foliis parvulis (majoribus sesquipollicaribus) subsessilibus. — Hills east of Santa Cruz, Sonora; Sept. (1138.)

B. CYLINDRACEA, *Gray;* a small variety. Western Texas; May.

B. WRIGHTII (sp. nov.): suffruticosa, minutim glanduloso-scabrella; caulibus ramosissimis; foliis plerisque alternis longe petiolatis deltoideo-ovatis (basi truncatis subcordatisve) acutis grosse-serratis subcoriaceis 3–5-plinerviis subreticulatis; thyrsis paniculatis polycephalis subfoliosis; capitulis pedicellatis; involucro cylindraceo 14–18-floro glabro purpurascente, squamis 3–4-seriatis obtusis, extimis ovalibus, intimis oblongo-linearibus; acheniis hirto-puberulis; pappo scabro. — Hills, near the copper mines, New Mexico; Oct. (1139.) — Stems 3 or 4 feet high, paniculately much branched, smooth; the branches, &c. very minutely glandular-scabrous. Leaves from the base of the stem not seen; the upper cauline all alternate, $1\frac{1}{2}$ to 2 inches long, and the petioles $\frac{1}{2}$ to $\frac{2}{3}$ inch long; those of the flowering branches similar but smaller, not numerous. The leaves are rigid, but not so coriaceous as those of B. baccharidea, not much reticulated. The very numerous heads are larger than in the last-named species (about 5 lines long), and the inflorescence more open. Pedicels $1\frac{1}{2}$ to 3 lines long. The scales of the involucre are nearly all tinged with purple, especially above the middle. In the arrangement of the species published in *Pl. Wright. p.* 84–86, this would stand between B. baccharidea and B. reniformis. It is probable that its lower leaves are cordate.

B. TENERA (sp. nov.): herbacea, puberula; caulibus adscendentibus ad apicem usque foliosis; foliis omnibus alternis longe petiolatis deltoideo-ovatis obtusis vel acutis crenato-dentatis membranaceis basi trinervatis in petiolum breviter attenuatis; capitulis axillaribus subsolitariis vel paucis in ramulos floridos petiolum haud su-

perantibus; involucre 12-floro cylindraceo glaberrimo, squamis pluriseriatis obtusis, exterioribus ovalibus oblongisve, intimis linearibus; acheniis puberulis; pappo scabro. — In a mountain ravine near Santa Cruz, Sonora; Sept. (1140.) — "Stems branching from the root, 1 – 3 feet high." Leaves very thin and membranaceous, one to two inches in length, longer than broad, especially the upper ones, not so veiny as those of B. reniformis, slightly if at all subcordate. Heads, about 5 lines long, on short pedicels. Involucre stramineous. — Perhaps too closely related to B. reniformis; but none of the leaves are reniform, nor so much dilated, and the heads are larger.

B. FLORIBUNDA (sp. nov.): herbacea; caule glabello erecto folioso superne paniculato; foliis alternis longe petiolatis glabris deltoideo-ovatis vel summis ovato-oblongis acutis dentatis triplinerviis venosis; corymbis polycephalis subaphyllis in paniculam compositam amplam laxam digestis; pedunculis pedicellisque glandulosopubescentibus erectis; involucro 18 – 20-floro pauciseriali basi 2 – 4-bracteato, squamis extimis oblongis seu lanceolatis acutis parce glandulosis, intimis linearibus obtusis glabris; acheniis puberulis; pappo scabro. — Ravines near Santa Cruz, and on rocky banks of the San Pedro, Sonora; Sept. (1141.) — Stems apparently 3 or 4 feet high; the ample compound corymbose panicle often a foot in length when fully developed, and bearing a large number of heads. Leaves sparsely resinous-punctate, and the floral ones glandular, otherwise glabrous, rather firm in texture, in shape much like those of Eupatorium ageratifolium, but alternate, the lower truncate at the base, slightly if at all subcordate, 2 to 3 inches long, 1½ to 2 inches wide at the base; the uppermost narrower and becoming acute or cuneate at the base. Bractlets lanceolate and linear. Heads 5 lines long, not pendulous. — A very distinct species, belonging to the same section as B. cordifolia.

B. FENDLERI, *Gray, Pl. Fendl. p.* 63. Sides of mountains, near the copper mines, New Mexico; Aug. (1142.) — Leaves both opposite and alternate.

B. GRANDIFLORA, *Nutt.; Torr. & Gray, Fl.* Sides of mountains, at the copper mines, New Mexico; Oct. (1143.)

B. SIMPLEX (sp. nov.): herbacea, glabella; caulibus e radice lignescente plurimis simplicibus apice nudo monocephalis vel 2 – 4-cephalis; foliis oppositis nunc alternis deltoideo-cordatis summis triangulato-hastatis crenato-dentatis basi trinervatis longiuscule petiolatis; involucro plusquam 20-floro pauciseriali basi breviter bracteolato, squamis lincaribus acutis; acheniis hirtellis; pappo barbellulato-scabro. — Hills east of Santa Cruz, Sonora; Sept. (1144.) — Stems slender, erect, 12 to 18 inches high. Leaves an inch or less in length, on petioles 4 to 6 lines long; the lowest broad and very obtuse; the upper successively more triangular-oblong and at length acute, strongly crenate-toothed towards the cordate base, almost glabrous. Peduncle 2 – 3 inches long, at least when solitary; when there are two or more heads the peduncle of the lower one is an inch long. Heads 7 or 8 lines long, larger than in B. grandiflora; the involucre resembling that of B. oblongifolia; but the scales narrower.

EUPATORIUM WRIGHTII, *Gray, Pl. Wright. p.* 87. Crevices of rocks, at Guadalupe Pass, New Mexico; Oct. (1145.) — Heads rather larger than in No. 254.

E. SOLIDAGINIFOLIUM, *Gray, l. c.*; var. caulibus 1 – 2-pedalibus subsimplicibus herbaceis e basi suffrutescente pubescentibus; foliis ovato-lanceolatis parce serratis magis venosis puberulis; panicula magis evoluta; capitulis 5 – 7-floris. — With the foregoing. (1146.) — These fine specimens require that the character of the species should be a little reformed.

E. AGERATIFOLIUM, *DC.*, var. ? HERBACEUM; caulibus basi tantum suffrutescente; foliis sæpius pl. m. cordatis. — Mountains, east of Santa Cruz, Sonora (a small-leaved form); also at Guadalupe Pass, and at the copper mines, under trees (a large-leaved form), Oct. (1147.) — Stems one to three feet high; the foliage in the dried specimens somewhat aromatic. — The longer petioles, acute scales of the involucre, and the pubescent achenia distinguish this from E. aromaticum. Although the stems are herbaceous nearly or quite to the base, it certainly is not specifically distinct from E. ageratifolium, var. Texense, which, like the present specimens, has from 12 to 22 flowers in the capitula. — The pappus in all my indigenous specimens is nearly as long as the corolla; but in a plant raised in the Cambridge Botanic Garden from Lindheimer's Texan seeds, the pappus is only half the length of the corolla; whence I suspect that E. Berlandieri, *DC.* belongs to the same species.

E. SONORÆ (sp. nov. Subimbricata): caulibus herbaceis gracilibus assurgentibus paniculato-ramosis pubescentibus; foliis longe petiolatis oppositis membranaceis deltoideis acuminatis grosse dentatis basi 3 – 5-nerviis puberulis; corymbis oligocephalis; involucro 24-floro subbiseriali, squamis oblongis bi – trinerviis, exterioribus acutiusculis pubescentibus, interioribus obtusis; corollis carneis; acheniis acute angulatis, angulis hirtellis. — Crevices of rocks, in a mountain ravine, near Santa Cruz, Sonora; Sept. (1148.) — Stems 10 to 20 inches long, often decumbent, striate. Leaves 12 to 18 lines long, on petioles of 4 to 10 lines in length, thin, conspicuously acuminate, deeply dentate with 6 or 8 strong and spreading teeth, or the upper with 3 or 4 on each side, truncate at the base, not cordate, the smaller rameal ones sometimes contracted at the base. Involucre two lines long. Pappus rather shorter than the corolla. — Allied to E. Schiedianum, *DC.*; from which its smaller heads, and smaller, more triangular, abruptly long-acuminate and incisely toothed leaves distinguish it. From E. multinerve, *Benth.*, which seems to be E. Schiedianum γ. diversifolium, *DC.*, it differs in nearly the same particulars, but I fear not sufficiently.

CONOCLINIUM DISSECTUM, *Gray, Pl. Wright. p.* 88, var. (= No. 259). Valleys, between Eagle Springs and the Rio Grande; June. (1149.)

MACHÆRANTHERA TANACETIFOLIA, *Nees, Ast. p.* 224; *Gray, Pl. Wright. p.* 90. Valley of the Pecos, in alluvial soil; June. Also near the San Pedro, Sonora, in low, damp soil; Sept. (1150.)

M. TANACETIFOLIA, var. humilis (spithamæa); involucro subturbinato, appendicibus foliaceis squamarum brevibus minus patentibus. — Near Ojo de Gavilan, New Mexico; Aug. (1151.) — The green tips of the involucral scales are scarcely more prolonged than in some forms of M. canescens.

M. TANACETIFOLIA, var. pygmæa (3 – 6-pollicaris); capitulis multo minoribus; involucro hemisphærico, squamis breviter appendiculatis. — Dry, stony hills, valley

of the Salado, Chihuahua, and near El Paso; April. (1395.) — A remarkably dwarf, precociously flowering state of the species.

M. CANESCENS, var. LATIFOLIA: scabro-pubescens vel puberula (viridi aut cinerea); foliis oblongis seu lanceolatis multidentatis obtusis; involucro squarroso, appendicibus subulatis. — Dieteria asteroides, *Torr. in Emory, Rep. p.* 142. Near the copper mines, New Mexico, and in Sonora near Deserted Rancho; Sept., Oct. (1152.) — Leaves from one third to two thirds of an inch wide; the somewhat hemispherical involucre half an inch in diameter. Rays mostly deep violet in the dried specimens.

M. PARVIFLORA, *Gray, Pl. Wright. p.* 90. Valley west of the Chiricahui Mountains, Sonora; Sept. (1153.)

PSILACTIS ASTEROIDES, *Gray, Pl. Fendl. p.* 72, *& Pl. Wright. p.* 91. On the Rio Grande, near El Paso; and in Sonora near the San Pedro. (1154.)

ASTER? (MEGALASTRUM; pappi setæ rigidæ, complanatæ, serrato-barbellatæ) WRIGHTII (sp. nov.): suffrutescens, subviscoso-pubescens; caulibus ramisve apice nudis monocephalis; foliis spathulatis integerrimis acumine setifero apiculatis in petiolum marginatum attenuatis; capitulo maximo; involucri biseriali squamis ovato-lanceolatis longe caudato-acuminatis. — Stony hills on the Rio Grande 60 or 70 miles below El Paso, near the cañon through which passes the road to San Antonio; March. — Unwilling to multiply the Asteroid genera, I append this remarkble plant to Aster, because if it had yellow rays I should not hesitate to refer it to the analogous genus Aplopappus. Yet the rigid bristles of the pappus (which, although stout and manifestly flattened under the lens, are still capillary), with so strong a denticulation as to become almost barbellate, and the membranaceous, long-acuminate scales of the involucre, taken with the rather peculiar habit, might justly entitle it to rank as the type of a new genus. It has higher claims to such a rank than Biotia, Heleastrum, &c. The involucre, as flattened in the dried specimens, is over an inch in diameter; and the puberulent-glandular scales are from 6 to 10 lines long, including the acumination. Rays 30 to 40, rather broad, 8 or 9 lines long, 2–3-toothed at the apex, purple, according to Mr. Wright. Receptacle nearly flat, alveolate. Disk-corolla, stamens, &c. as in Aster; so is the style, except that the hispid appendages are rather short and obtuse. Ovaries compressed, villous. Pappus white, similar in the disk and ray, about the length of the disk-corollas, not very copious; the bristles stouter even than in A. eryngiifolius, *Torr. & Gr.*, manifestly flattened, taper-pointed, unequal, the smallest half the length of the longer ones and more slender. Stems about a foot high, from a lignescent base, angled. Leaves one to two inches long, including the tapering base or petiole, obscurely veined, 4 to 8 lines wide, abruptly mucronate-acuminate, and with the point extended into a setiform cusp. — Unfortunately only two specimens were seen in flower at the early season when it was discovered. It has doubtless been since collected by Dr. Bigelow or Dr. Parry.

ASTER MULTIFLORUS, *Ait.; Torr. & Gray, Fl. 2. p.* 125 (fere β). Stony hills near the copper mines, New Mexico; and near Santa Cruz, Sonora; Aug., Sept. (1155.) Also on prairies of Zoquete Creek, Texas; — a cinereous form, with small

and fascicled or crowded leaves, and small heads; exactly A. hebecladus, *DC.* (1396.)

A. MULTIFLORUS, *Ait.*, γ. COMMUTATUS, *Torr. & Gray, l. c.* Rocky mountain-sides, at the copper mines, New Mexico; Oct. (1156.) Also, a large form, with more paniculate heads, of unusual size, passing to A. falcatus.*

A. PUNICEUS, *Linn.*, γ. VIMINEUS, *Torr. & Gray, Fl. 2. p.* 141. Margin of springs, valley of the Sierra de los Animos, New Mexico; Oct. (1157.)

A. LONGIFOLIUS, *Lam.; Torr. & Gray, Fl. 2. p.* 139. Low bottom of the Mimbres, New Mexico; Nov.

A. NOVI BELGI, *Linn.*? var. foliis membranaceis. — In thickets, on the Mimbres; Oct. (1758.) — A. Novi Belgi and A. longifolius will absorb several nominal species.

A. SIMPLEX, *Willd.; Torr. & Gray, Fl. 2. p.* 131. Banks of the Barbocomori, Sonora; Sept. (1159.) — There is more than one prior name for this species.

A. SPINOSUS, *Benth. Pl. Hartw. p.* 20. Low grounds, on the Rio Grande, near San Elizario; June. (1397.)

A. DIVARICATUS, *Nutt.; Torr. & Gray, l. c.* Banks of the Rio Grande, and of the San Pedro, Sonora. (1160.)

A. ANGUSTUS, *Torr. & Gray, l. c.* Tripolium angustum, *Lindl.* Crinitaria humilis, *Hook. Fl. Bor.-Am.* Aster (Tripolium) frondosus, *Nutt.* Conyza Altaica, *DC.* Sand-bars of the Rio Grande, below Doña Ana, New Mexico; July. (1161.) — The older stems are not strict, but diffusely spreading, the lateral ones procumbent. The root is annual or biennial.

A. PAUCIFLORUS, *Nutt. Gen. 2. p.* 154; *Torr. & Gray, l. c.* A. caricifolius, *H. B. K.! Nov. Gen. & Spec. 4. p.* 92. *t.* 333. Tripolium caricifolium, *Schauer in Linnæa*, 19. *p.* 721. Valley west of the Chiricahui Mountains, in damp, subsaline soil, and near Santa Cruz, Sonora; Sept. (1162.) — Well distinguished by its rigid foliage, and the viscid pubescence or glandulosity of the flowering branchlets, bracts, and pauciserial involucre. The rays when fresh are blue or purple. It is the same as the Mexican plant of Humboldt and Bonpland above cited.

A. PAUCIFLORUS, var. caule tenero, foliis angustissime linearibus. — Las Playas Springs, New Mexico, in subsaline soil; Oct.

A. (OXYTRIPOLIUM) SONORÆ (sp. nov.): glaberrimus; radice annua vel bienni; caule e basi ramoso; ramis patentibus rigidis foliosis; foliis infimis oblanceolatis inciso-dentatis basi attenuatis, superioribus linearibus rariter spinuloso-denticulatis mucronatis; capitulis solitariis majusculis; involucri hemisphærici squamis pluriserialibus gradatim imbricatis lineari-lanceolatis acutissime acuminatis appressis glabris; ligulis exsertis; acheniis sericeo-pubescentibus. — Low valley, in subsaline soil, west of the Chiricahui Mountains, and at San Bernardino, Sonora; Sept. (1163.) — "Stems 10 to 18 inches high, branched from the base; the branches rigid. Leaves about an inch long, thickish, veinless; those of the flowering branchlets small and subulate. Heads about half an inch in diameter, hemispherical. Scales of the involucre all short, the greenish tips subulate-pointed. Rays

* A. Fendleri, *Gray, Pl. Fendl. p.* 66, appears to be only a form of A. Nuttallii, *Torr. & Gray.*

30 – 40, slender, purple. — A very distinct species, with the heads as large as in A. Moranensis, *H. B. K.* (to which probably belongs A. purpuratus, *Nees*), and nearly as large as in A. flexuosus, not at all turbinate at the base; the scales closely imbricated in numerous series.

A. (Oxytripolium) blepharophyllus (sp. nov.): surculoso-cæspitosus, humilis, glaber; foliis linearibus vel surculorum lineari-spathulatis eximie setoso-ciliatis, ramorum brevissimis; ramulis fastigiatis monocephalis; involucri turbinati squamis pluriserialibus oblongis acutis chartaceis; ligulis 10 – 14 oblongis exsertis; acheniis sericeis. — Las Playas Springs, New Mexico, in subsaline soil; Oct. (1164.) — "Plant forming large patches," the flowering stems a span high. Leaves, more especially those of the surculose shoots, conspicuously fringed with strong white bristles of a length nearly equal to the breadth of the leaf, and the apex tipped with a similar bristle; the upper cauline and rameal only one or two lines long, and soon reduced to subulate bracts less fringed or naked. Heads 3 lines long; the one-nerved scales of the involucre with minutely scarious and ciliolate margins.

Erigeron macranthum, *Nutt.; Gray, Pl. Fendl. p.* 67. Stony hills at the copper mines, New Mexico; Aug., Oct. (1165.) — The stems are hispid, more so than in Fendler's No. 330.

E. Bellidiastrum, *Nutt.; Gray, Pl. Fendl. p.* 67. Near El Paso? (locality not recorded).

E. modestum, *Gray, Pl. Fendl. p.* 68, *& Pl. Wright. p.* 90. Prairies of Live Oak Creek, &c.; May. (1166.)

E. divergens, *Torr. & Gray, Fl. 2. p.* 175; *Gray, Pl. Wright. p.* 91. Valleys of the Pecos, Limpio, and Rainwater Creek, in alluvial soil; June: and sides of the Organ Mountains. (1167.) Also on mountains at the copper mines, New Mexico; Aug.: a still more flagelliform state (E. flagellare, *Gray, Pl. Fendl.*). (1168.)

E. divergens, var. cinereum, *Gray, Pl. Wright. l. c.* Mountains, around the copper mines; Oct: a late, much-branched state. (1169.) Hills near El Paso; March, April: the early, normal form. (1398.)

E. (Polyactidium) delphinifolium, *Willd. Hort. Berol. t.* 90. Polyactidium delphinifolium, *DC. Prodr. 5. p.* 282. On mountains at the copper mines, common; Aug. – Oct. (1170.)

E. (Cænotus) eriophyllum (sp. nov.): annuum? floccoso-lanatum; caule erecto superne paniculato, ramulis patentibus monocephalis; foliis sessilibus, inferioribus spathulatis vel oblanceolatis versus apicem dentatis, superioribus linearibus integerrimis; involucri squamis glabratis 3 – 4-seriatis, exterioribus brevioribus; ligulis pluriserialibus purpurascentibus pappum simplicem haud superantibus; acheniis plano-compressis hirtellis margine crasso cinctis. — On the Sonoita, near Deserted Rancho, Sonora; Sept. — Stem a foot or more in height. Leaves 12 to 16 lines long, the white and floccose wool at length nearly deciduous from the upper surface. Heads 4 lines long, hemispherical, many-flowered. Ligules narrowly linear. Achenia all fertile, flat, obovate, with a small terminal areola. Pappus entirely simple and capillary, rather longer than the disk-flowers, white, deciduous, the bristles slightly connected at the base. — This plant much resembles the figure of

Erigeron gnaphalioides, *H. B. K.* (Heterochæta? gnaphalioides, *DC.*), except that the panicle consists of fewer, longer, and more spreading branches, and there is no trace of the short exterior pappus which is so conspicuous in Kunth's figure. It is manifestly an Erigeron, of the section Cænotus, to which Mr. Bentham, no doubt correctly, adduces those American Conyzæ of De Candolle with fertile hermaphrodite flowers.*

Diplopappus ericoides, *β.* hirtella, *Gray, Pl. Fendl. p.* 69. Stony hills near El Paso; April: a stout, vernal form, like Fendler's No. 348. Prairies from Live Oak Creek to the Rio Grande and the copper mines, New Mexico. (1171.)

Townsendia strigosa, *Nutt.; Gray, Pl. Fendl. p.* 70. Sandy banks of the Rio Grande, above Doña Ana; July. Stony hills near El Paso; March, April. (1172.) — The plant begins to flower when only an inch high; at length it attains the height of 3 or 4 inches. The root is long and filiform.

Distasis modesta, *DC. Prodr. 5. p.* 279; *Gray, Pl. Wright. p.* 91. Rocky prairies and hills, from Turkey Creek, Texas, to Providence Creek. (1173.)

Keerlia bellidifolia, *Gray & Engelm. Pl. Lindh. 2. p.* 220, *& Pl. Wright. p.* 91. Sand-bars of the Nueces; May.

Aphanostephus ramosissimus, *DC.; Gray, Pl. Wright. p.* 93. Prairies of the Sabinal and Nueces, Western Texas; May. (1174.)

A. humilis, *Gray, Pl. Wright. l. c.* Sandy bed of streams, from Eagle Springs to the Rio Grande; June. Near El Paso; March – May. (1175.)

Bellis integrifolia, *Michx.* Valley of the Pecos to the Prairie-dog towns beyond the Limpio; June. (1176.)

Gutierrezia (Hemiachyris) Wrightii (sp. nov.): radice annua; caule erecto gracili pedali apice corymboso-paniculato; ramis monocephalis; foliis linearibus planis; capitulis turbinato-hemisphæricis; ligulis 12; acheniis glabris; pappo in radio et disco conformi brevissimo coroniformi margine fere integerrimo. — Margin of dried-up streams, between Barbocomori and Santa Cruz, Sonora; Sept. (1177.) — Stem somewhat striate-angled, strict, simple, or corymbosely branched at the summit; each branch or peduncle terminated by a solitary head. Leaves thin, 12 to 20 lines long, and a line and a half wide, rather obtuse. Heads pretty large for the genus, nearly the size of those of G. (Brachyris, *DC.*) paniculata, not half as large as in G. Alamani. Scales of the involucre with short and obtuse green tips. Ligules nearly 3 lines long. Disk-flowers 20 or more, all fertile. Appendages of the style linear-lanceolate, acute. Pappus strictly coroniform, with the even edge entire or very obscurely denticulate. — An interesting accession to the genus, on account of the annual root and the entire pappus. In the allied G. Alamani, *Gray, Pl. Wright. p.* 91, as in other species of the section, it is coroniform, but strongly toothed or lobed. The shape of the appendages of the style, as well as the presence of a pappus, distinguishes this and G. Alamani from Xanthocoma. The fol-

* Erigeron gnaphalioides, *H. B. K.* is plainly a congener of the Conyza gnaphalioides, *H. B. K.* (to which, if I mistake not, belongs Heterochæta stricta, *Benth. Pl. Hartw.*), the type of Cassini's genus Lænnecia, which should rank merely as a subgenus of Erigeron, between Cænotus and Stenactis; differing from the former in the conspicuous exterior pappus, from the latter in the short rays as well as in habit.

lowing plant, however, with much the habit of an enlarged Gymnosperma, has short and broad appendages to the style. Yet I cannot separate it from the genus Gutierrezia.

G. ? (Hemiachyris) gymnospermoides (sp. nov.): caule herbaceo valido subsimplici; foliis lanceolatis vel oblongo-lanceolatis inferne attenuatis apicem versus sæpius denticulatis mucronato-acutis glutinosis penninerviis; capitulis confertissime corymbosis hemisphæricis fere omnibus pedicellatis; involucri squamis lincaribus acutis; receptaculo planiusculo; ligulis 25–30 angustis discum vix superantibus; fl. disci 40–60; acheniis radii glaberrimis calvis, disci minute hirtellis pappo coroniformi dentato lacero et in fl. centralibus setoso-paleaceo superatis. — Low banks of the San Pedro, Sonora; Sept. (1178.) — "Stem 2 to 4 feet high," very leafy to the top, terete. Leaves about 3 inches long, 4 to 6 lines wide, rather thin, rather obscurely feather-veined. Heads very numerous, cymose-crowded at the summit of the stem and of the short flowering branches, forming an ample compound corymb. Involucre glutinous, hemispherical, about 3 lines in diameter; the scales with loose or spreading tips. Receptacle nearly flat, alveolate. Ligules linear-oblong, not longer than their filiform tube. Appendages of the style in the disk-flowers ovate-triangular, acute. Achenia oblong, compressed; those of the ray perfectly glabrous, with a small terminal areola, entirely destitute of pappus; those of the disk minutely and sparsely hairy, with a toothed and lacerate coroniform pappus, which in the exterior flowers is very short, or sometimes obsolete, in the central flowers larger and often produced into 4–8 unequal rigid setiform paleæ, the larger occasionally nearly as long as the achenium.

G. (Hemiachyris) sphærocephala, *Gray, Pl. Fendl. p.* 73. Banks of the Rio Grande near El Paso; June, in flower. Hills near the copper mines, New Mexico; Oct. (1179.) — Root annual! Stems a span to a foot high, diffusely very much branched, bearing very numerous solitary heads; the upper leaves reduced to subulate bracts. Heads 2 lines in diameter. Achenia turbinate, silky-villous, especially on the 10 strong ribs. Pappus in these specimens all truly coroniform, as long as the proper tube of the disk-corollas, fully half the length of the achenium, irregularly 4–5-lobed or toothed; the lobes mostly obtuse, short, erose. — Those from the copper mines are well-developed specimens of the same plant as Fendler's No. 343, which was immature. No. 315 of Coulter's Mexican collection may be a variety of this, with the paleæ much less concreted. G. eriocarpa differs principally in the multipaleate pappus.

G. microcephala, *Gray, Pl. Fendl. l. c., & Pl. Wright. p.* 94. Mountains at Guadalupe Pass, New Mexico; Oct. (1180.)

S. mollis, *Bartl. Ind. Sem. Hort. Gœtt.* 1836; *DC. Prodr.* 7. *p.* 279. S. incana, *Torr. & Gray, Fl.* 2. *p.* 221 (*α* & *β*). Sides of mountains at the copper mines, New Mexico; Aug. and Oct. Also on the Limpio. (1181.) — It runs, I fear, into S. nemoralis, and certainly is not distinct from S. nemoralis *γ*, *Torr. & Gray.*

S. petiolaris, *Ait.*; *Torr. & Gray, l. c.*; at least the plant of *Pl. Wright. p.* 94. With the preceding. (1182.)

S. occidentalis, *Nutt. in Torr. & Gray, Fl.* 2. *p.* 226. Thickets, in the bottom of the Mimbres, New Mexico; Oct. (1183.)

Linosyris graveolens, *Torr. & Gray, Fl.* 2. *p.* 234; var. approaching L. albicaulis. Pebbly bed of a creek near Sierra de los Animos, New Mexico; Oct. (1184.) — "Stem erect, branched, 4 to 6 feet high." There is a slight pubescence on the tube of the corolla, but not the long, cobweb-like hairs of S. albicaulis.*

L. pulchella, *Gray, Pl. Wright. p.* 96. Sandy ridges along the banks of the Rio Grande, near Frontera; Nov. (1185.) — No. 287, the locality of which was accidentally omitted, was gathered on prairies below El Paso.

L. Wrightii, *Gray, Pl. Wright. p.* 95, & var. foliis inferioribus pinnatifido-dentatis. — Low banks of the Rio Grande, New Mexico; growing in large bunches; Nov. (1186.) — A few specimens of a minutely hirtello-scabrous variety of this species were gathered on the Rio Grande near Doña Ana, in July; which probably connects L. hirtella with this species.

L.? carnosa (sp. nov.): glabra; caulibus e basi suffrutescente ramosissimis diffusis rigidis, ramulis patentibus monocephalis; foliis linearibus (subteretibus?) carnosis glaucescentibus, ramealibus sensim abbreviatis subulatis; involucro campanulato 40-floro, squamis 3 – 4-seriatis lanceolatis acuminatis; acheniis sericeo-pubescentibus. — Low, subsaline valley, west of the Chiricahui Mountains, Sonora; Sept. (1187.) — I am doubtful of the genus of this plant, which looks as if it might be a Tripolium without rays. The rigid, but herbaceous, spreading stems are two feet or more in length, bearing numerous alternate leaves, which were fleshy and appear to have been terete or laterally flattened; the lower ones an inch long; those of the flowering branches reduced to minute subulate bracts. The herbage has a strong saline and acrid-bitter taste. The involucre is 3 or 4 lines long, a little shorter than the disk; the scales regularly imbricated and appressed, the exterior successively shorter. Pappus copious, tawny. Appendages of the style slender, linear-subulate.

L. (Aplodiscus) ramulosa; *Gray, Pl. Wright. p.* 97. Aplopappus (Aplodiscus) ramulosus, *DC.! Prodr.* 5. *p.* 350. Ravines, at the base of the Organ Mountains, New Mexico; April. (1400.) — Stems 1 – 2 feet high, much branched. Plant with somewhat the habit of Aster multiflorus.

Aplopappus (Ericameria) laricifolius (sp. nov.): fruticosus, humilis, fastigiato-ramosissimus, glaber; foliis confertis angusto-linearibus basi attenuatis mucronulatis integerrimis rigidis uninerviis crebre punctatis subresinosis; capitulis ramulos foliosos terminantibus corymbosis; involucro turbinato disco breviore, squamis 3 – 4-seriatis lineari-subulatis appressis; ligulis 5 – 6; fl. disci circiter 12; acheniis sericeo-villosis oblongis. — On mountains, at Guadalupe Pass, New Mexico; Oct. (1188.) — "Shrub a foot high, very much branched." Leaves 6 to 9 lines long, less than a line wide, very much crowded on the branches, but not fascicled. Heads 4 lines long, fastigiate-corymbose. Ligules 2 – 3 lines long. Appendages of the style in the disk-flowers linear, rather obtuse, shorter than the long and linear stigmatic portion. Bristles of the pappus not very copious, slender and

* Linosyris serrulata, *Torr. in Stansbury's Rep. p.* 289, is only a form of L. pumila (Chrysothamnus pumilus, *Nutt.*), the L. viscidiflora, *Torr. & Gray.*

capillary, soft, all alike except in length. — This plant destroys the genus Ericameria, *Nutt.*, which, as a section of Aplopappus, forms another point of connection between that genus and Linosyris; Ericameria resinosa, *Nutt.*, being nearly undistinguishable from Linosyris viscidiflora, except in having from two to six rays.

A. (Blepharodon) spinulosus, *DC.* Prairies, &c. from Zoquete Creek, Texas, to New Mexico. (1189.) Also, the nearly glabrous variety, from New Mexico, and a valley west of the Chiricahui Mountains, Sonora. (1190.)

A. gracilis, *Gray, Pl. Fendl. p.* 76, *& Pl. Wright. p.* 97. Valley of the Rio Grande, New Mexico, and near the San Pedro, Sonora; Sept. (1191.)

Chrysopsis foliosa, *Nutt.*, var. *Pl. Wright. no.* 299. *p.* 99. Hills, near the Mimbres, New Mexico; Nov.

C. foliosa, var. sericeo-villosissima, incana; capitulis quam in pl. Nutt. majoribus; ligulis elongatis. — Valley between the San Pedro and the Sonoita, Sonora; Sept. — Heads half an inch long, bracteate with leaves. Exterior pappus very manifest, as in all the forms of this species; the short setæ rather than squamellæ often half the length of the achenium.

Grindelia arguta, *Schrad. in DC.?* forma glabra. Sonora? (the locality not recorded).

G. squarrosa, *Dunal*, fere var. grandiflora, *Gray, Pl. Wright. p.* 98. Prairies on the Manzanal, Western Texas; July.

Laphamia (Pappothrix) rupestris, *Gray, Pl. Wright. p.* 100. *t.* 9. Crevices of basaltic rocks, on mountains of the Limpio; June. (1192.)

L. halimifolia, *Gray, l. c.* Hills of the San Pedro, Western Texas; May. (1193.)

L. angustifolia, *Gray, l. c.* High, rocky hills of the Pecos; June. (1194.)*

PERICOME, *Nov. Gen.*

Capitulum multiflorum, homogamum. Involucrum disco brevius, campanulatum, uniseriale; squamis circ. 20 linearibus per margines angustissimos hyalinos inter se coalitis. Receptaculum planiusculum nudum. Flores omnes hermaphroditi. Corollæ tubulosæ, tubo gracili viscoso-glanduloso, fauce cylindracea, dentibus 4 ovatis patentibus. Antheræ exsertæ, basi subsagittatæ. Styli rami filiformes, leviter complanati, obtusiusculi, extus superne et apice minute hirtelli. Achenia lineari-oblonga, compressa, faciebus glaberrima, marginibus nerviformibus undique barbato-

* Dr. Torrey has furnished the characters of the subjoined new species of Laphamia, which is remarkable, both for its finely dissected foliage, and for having a pappus of a single seta in some flowers, in others none at all; — thus confirming the union of Monothrix, *Torr.* with Laphamia vera.

"Laphamia dissecta (sp. nov.): nana, patenti-pubescens; caulibus e basi ramosis; ramis foliosis monocephalis; foliis plerumque alternis subrotundo-cordatis pedato-multisectis, segmentis oblongo-linearibus confertis; ligulis nullis; fl. disci circiter 20; pappo e seta unica corollæ tubum æquante vel sæpius nullo. — Crevices of rocks, on mountains, near Presidio del Norte, Aug., 1852, *Dr. J. M. Bigelow.* — Stems 3 or 4 inches high, lignescent at the base; the numerous branches mostly simple. Leaves scarcely one third of an inch long, cut into numerous minute and crowded segments. Heads 4 or 5 lines in diameter. Scales of the involucre about 15. Achenia hispid on the margins, blackish when mature." *Torrey, Mss.*

ciliata. Pappus squamellato-coroniformis, fimbriato-lacerus, fimbriis pilos validos achenii simulantibus. — Herba glabella, ramosa, procera; foliis oppositis summisve subalternis triangulatis vel hastatis longissime acuminatis levissime resinoso-punctatis haud glandulosis; capitulis cymosis; floribus flavis.

Pericome caudata. — Among rocks, on the sides of mountains, at the copper mines, New Mexico; Oct. (1195.) — "Plant 4 feet high, much branched, growing in large bunches." Base of the stem not gathered. Branches terete, striate, sparingly puberulent. Leaves nearly all opposite, on long petioles, membranaceous, 3-nerved at the base, dilated triangular, or the upper hastate, with the basal angles usually acuminate or more or less produced, often angulate-toothed below the middle, the apex produced into a very long tail-like acumination. The larger leaves in the specimens are 3 inches broad at the nearly truncate base, and 4 inches long, including the acumination, which is 1½ to 2 inches in length; the uppermost are narrower, but equally caudate. They are sparingly puberulent, especially on the veins, sparsely sprinkled or dotted with minute resinous atoms, like a Eupatorium; but not at all pellucid-glandular after the mode of Tagetineæ. Heads in terminal cymes or corymbs, on slender pedicels, half an inch long. Involucre not bracteate, about 3 lines long; the scales very narrowly linear, one-nerved, their narrowly scarious margins lightly but decidedly coalescent to near the apex, the free tips lanuginous-ciliate. Corolla with the elongated and exserted anthers 3 lines long, yellow; the slender tube very viscous-glandular, about the length of the cylindraceous throat and short limb. Branches of the style convex externally, slightly flattened, the rather indistinct stigmatic lines extending to very near the summit, and there insensibly vanishing, where a fine pubescence begins; the same pubescence extends down the back considerably lower, and disappears insensibly. Achenia 2 lines long, much compressed, margined all round with a strong callous nerve, which bears a dense and conspicuous beard of hispid hairs. Pappus rather shorter than the beard of the achenium, composed of numerous setiform squamellæ which are irregularly united below into a hyaline lacerate crown. There is no trace of any awns. — A genus of even more doubtful position in the family than Perityle, *Benth.*, which with Laphamia, I have continued to append to the Asteroideæ. It agrees with Perityle in the achenia and the (disk) corollas, in the prevailingly opposite leaves, and very nearly in the style; but differs in the absence of a ray, as well as of awns to the pappus, and in the coalescence of the strictly uniserial scales of the involucre. The style would almost do for the Eupatoriaceæ; but the stigmatic lines are continued almost to the tip; and the flowers are yellow. The involucre is like that of Hymenatherum, and the style is exactly that of a Tagetes; but there are no large pellucid glands, and the achenia are flat. Notwithstanding, I should append the genus to Tagetineæ, were it not for the many points of resemblance to Perityle.

Perityle coronopifolia (sp. nov.): multicaulis e caudice suffrutescente, humilis, puberula; foliis parvis, inferioribus oppositis trisectis segmentis tripartitis vel pinnatipartitis, superioribus alternis pinnato-5 – 7-partitis lobis linearibus, summis sæpe integris; receptaculo subconvexo; ligulis oblongis albis; appendicibus styli fl.

herm. subulatis; acheniis oblongis facie glabratis marginibus hispido-villosissimis; aristis pappi 2 barbellato-scabris corolla disci paullo brevioribus. — Sides of mountains at the copper mines, New Mexico, Oct.; also on mountain-summits near Conde's Camp, Sept.; growing in crevices of rocks. (1196.) — Stems a span high, simple or branched from the somewhat ligneous base, sparingly branched at the summit, the branches terminated by single heads. Leaves rather crowded, 3 to 5 lines long, cinereous-puberulent, dissected into small and mostly linear lobes; the uppermost linear or oblong, sparingly lobed, or often entire. Involucre 2 or 3 lines long; the scales linear or lanceolate, cinereous, biserial, often purplish when old. Ligules nearly 3 lines long, broadly oblong, truncate and three-toothed at the apex, white. Disk-corollas rather short, 4-toothed. Pappus of numerous somewhat confluent hyaline squamellæ, forming a crown, and of two slender awns. — A genuine Perityle, although the foliage is finely dissected, much more so than even in Perityle nuda, *Torr.*, an unpublished species from the Rio Gila.

Baccharis cærulescens, *DC. Prodr.* 5. *p.* 402. Banks of the Rio Grande and of the Mimbres, New Mexico; June, Oct. (1197.)

B. salicina, *Torr. & Gray, Fl.; Gray, Pl. Wright. p.* 101. Banks of the Rio Grande, below El Paso; June. (1198.)

B. brachyphylla (sp. nov.): suffruticosa; caulibus ramosissimis diffusis angulato-striatis glabris; foliis minutis bracteæformibus linearibus vel subulatis integerrimis hirtello-scabris; capitulis pl. fœm. ramulos terminantibus laxe paniculatis; involucro pauciseriali disco breviore, squamis puberulis oblongo-lanceolatis acuminatis margine scariosis; acheniis glabellis. — Between Conde's Camp and the Chiricahui Mountains, in stony soil; Sept. (1199.) — Stems 2 or 3 feet high, slender, excessively branched, very bushy. Cauline leaves 2 to 3 lines long; those of the branches successively shorter, at length reduced to minute bracts. Female heads 2 to 3 lines in length, 12–14-flowered. Pappus short, fulvous. Sterile plant not seen.

B. ptarmicæfolia, *DC. Prodr.* 5. *p.* 419? Mountain ravine at Santa Cruz, Sonora; Sept.: the male plant. (1200.) — The heads are corymbose; the leaves mostly much smaller than is described by De Candolle; the larger are somewhat 3-veined, or rather triplinerved; but the smaller ones not at all so, nor much if at all acuminate. I should refer this rather to B. thesioides, but the bristles of the pappus are clavellate-thickened above. A female plant, which better accords with De Candolle's character, is in Seeman's collection from Northwestern Mexico.

B. ptarmicæfolia, *DC.*? or var. of B. thesioides? Hill-sides, between Barbocomori and Santa Cruz, Sonora; Sept.: the female plant. (1201.) — This is without much doubt the female plant of the last. The small heads are paniculate. The leaves are about an inch long and barely a line and a half wide, not acuminate, tapering to the base, thickly and strongly spinulose-serrulate. Pappus white.

B. Texana, *Gray, Pl. Fendl. p.* 75, & *Pl. Wright. p.* 101. Valley of the San Pedro, and near Comanche Spring, Western Texas; July. (1401.)

B. Wrightii (*Gray, Pl. Wright. p.* 101): herbacea, glaberrima; caulibus e basi suffrutescente ramosissimis gracilibus flexuosis ramisque acute angulatis, ramulis apice monocephalis; foliis sparsis parvis linearibus et lineari-subulatis integerrimis

uninerviis; involucro hemisphærico pauciseriali, squamis lanceolatis acuminatis scarioso-marginatis; pappo fusco, fl. fœm. involucro subduplo longiore. — Sandy hills between Cimieluque Springs and the Salado, Chihuahua, April: the female plant. (1402.) — This accords very well with the male plant collected in Mr. Wright's first journey (No. 307); but the fertile heads are larger and fuller than the sterile, half an inch in length, many-flowered, and with a copious pappus of a fulvous hue, manifestly inclining to reddish. The scales of the involucre are 3–4-serial, very smooth, with a green centre, and more conspicuous hyaline margins than in the sterile plant.

B. Wrightii, var. pyrrhopappa: humilis (semipedali), divergenti-ramosissima; foliis plerisque brevissimis; pappo fl. fœm. rubiginoso vel rubescente involucrum plusduplo superante. — (Near Mapimi, Durango, *Dr. Gregg.*) Prairies from Rainwater Creek to Rock Creek, around Prairie-dog towns; June. (1403.) — The fertile plant of the preceding enables me to identify this as a variety of B. Wrightii, of which before the sterile plant alone was known. The mature pappus is half an inch long, of a reddish hue, in Gregg's specimens almost sanguineous.

Tessaria (Phalacrocline) borealis, *Gray, Pl. Fendl. p.* 75, *& Pl. Wright. p.* 102. Low banks of the Rio Grande, New Mexico; May, Nov. (1202.)

Filaginopsis multicaulis, *Torr. & Gray, Fl.* 2. *p.* 263. Rocky hills of the San Pedro, Western Texas; May. Hills near El Paso; March, April: a small, vernal form. (1404.)

Stylocline micropoides (sp. nov.): pygmæa, albo-lanata; paleis receptaculi oblongis basi involutis dorso lanosissimis; pappi fl. masc. setis lævibus. — Hills near Frontera, New Mexico; April. (1405.) — A very woolly, small herb, with the habit of a diminutive Micropus erectus, beginning to blossom when only an inch high; when the stem is terminated by several heads in a glomerate cluster, surrounded by linear-lanceolate leaves of 3 or 4 lines in length, similar to the cauline ones. It soon branches more or less from the base, and is often proliferous from the glomerule. Heads ovoid or subglobose, 2 or 3 lines in length, rather larger than those of S. gnaphalioides, and much more woolly; the paleæ being thickly covered with long and implexed wool, except the scarious tip. These are like those of the Californian species, except that they are narrowly oblong (instead of broadly ovate), and with the lower part, inclosing the flower, contracted and wholly infolded, instead of having a mere saccate fold in the keel. Receptacle columnar and elongated; the fructiferous paleæ, looking like little pellets of wool, falling away at maturity. Sterile flowers 3 or 4 at the apex of the receptacle, naked, or barely subtended by oblong and glabrous paleæ; the abortive ovaries furnished with a very fugacious pappus of three or four slender and smooth, slightly clavellate bristles. Anthers caudate. Achenia obovoid-oblong, slightly compressed, nearly straight. — A true congener of S. gnaphalioides. I see nothing to separate it, nor the other Evacoid genera, from the Gnaphalieæ.

Diaperia prolifera, *Nutt.; Torr. & Gray, Fl.* 2. *p.* 264. Stony hills of the Pecos; May. (1406.) — A very depressed form.

Borrichia frutescens, *DC.* Banks of the Pecos; June: in patches. (1407.)

Silphium scaberrimum, *Ell.*, var. *γ. Torr. & Gray, Fl.* 2. *p.* 279. Thickets on the Sabinal, Texas; July. (1408.)

Berlandiera lyrata, *Benth. Pl. Hartw. p.* 17; *Gray, Pl. Fendl. p.* 78. Valley of Live Oak Creek, Western Texas; May. On Mule Creek, New Mexico; July. (1203.)

Melampodium cinereum, *DC.*; *Gray, Pl. Fendl. l. c.*, & *Pl. Wright. p.* 103. On the Leona and San Felipe, Western Texas; May: the variety that corresponds to M. ramosissimum, *DC.!* (1204.) Hills near El Paso; April: the form described as M. leucanthum, *Torr. & Gray*, and No. 311 of the collection of 1849.

M. hispidum, *H. B. K. Nov. Gen. & Spec.* 4. *p.* 273. *t.* 399. Valleys between the San Pedro and Santa Cruz, Sonora; Sept. (1205.) — A slender state of the species. The ligules are extremely short, 2–3-toothed.

Parthenium incanum, *H. B. K. l. c. p.* 260. *t.* 391; *Gray, Pl. Wright. p.* 103. P. ramosissimum, *DC. Prodr.* 5. *p.* 532. Prairies at Cook's Spring, between the Rio Grande and the Mimbres; July. (1206.)

Euphrosyne ambrosiæfolia, *Gray, Pl. Wright. p.* 102. Sides of mountains, near Conde's Camp, New Mexico; Aug. (1207.) — "Stems branching widely." Cauline leaves ovate in circumscription, tripinnatifid; the divisions and lobes crowded. — Cyclachæna xanthiifolia is plainly a congener of this; and that genus must accordingly be reduced to Euphrosyne, notwithstanding the minute rudiment of a corolla in the fertile flowers. — The following plant has nearly the habit of Euphrosyne xanthiifolia, with a floral structure intermediate between that genus, or Iva, and Parthenium.

PARTHENICE, *Nov. Gen.*

Capitulum hemisphæricum monoicum; floribus fœmineis 6–8 in ambitu, masculis 40–50 in disco. Involucrum biseriale; squamis herbaceo-membranaceis, exterioribus 5 ovalibus, interioribus 6–8 paullo majoribus orbiculari-obovatis. Receptaculum convexum, ambitu serie simplici palearum instructum, paleis linearinavicularibus carnoso-coriaceis per paria ima basi ovariorum fertilium utrimque accretis, in disco paleis minimis setaceis vel obsoletis inter ovaria abortiva. Corollæ radii subtubulosæ, obliquæ, intus fissæ, extus 2–3-dentatæ, discum demum subæquantes, styli ramis lato-linearibus dimidio breviores, deciduæ. Flores disci steriles Ivæ. Achenia (radii) obovato-oblonga, obcompressa, glabra, faciebus tuberculis minimis parcis scabra, vix marginata, vertice incurva apiculata, obliqua, intus dente minimo squamaceo instructa, ab involucri squamis discreta, cum paleis vacuis receptaculi utrimque quasi bracteolata secedentia. — Herba annua? orgyalis, pube brevissima molli undique cinerea; foliis omnibus alternis ovatis, majoribus subcordatis, acuminatis duplicato-dentatis; paniculis foliosis laxis; capitulis longiuscule pedicellatis parvulis.

Parthenice mollis. — Mountain ravine at Santa Cruz, Sonora; Sept. (1208.) — I have also raised this from seeds, in the Cambridge Botanic Garden. It is an herb of from 4 to 6 feet high, paniculately branched above, with the aromatic odor of an Artemisia, and with much the aspect of Euphrosyne xanthiifolia, except that

the leaves are all alternate, and clothed, like the rest of the plant, with a fine and very soft velvety pubescence, and the larger heads (2–3 lines in diameter) are all distinctly pedicelled. Leaves triplinerved; the larger ones 6 to 8 inches long. Inner scales of the involucre with scarious margins, nearly plane, not wrapped around the achenia, nor adherent to them at the base. Corollas greenish, pubescent above; those of the fertile flowers scarcely half the length of the ovary; those of the disk stipitate on the abortive ovaries, funnel-form, 5-toothed. Achenia a line long, rather shorter than the purplish paleæ that are attached to their base, one on each side, and which, when detached, do not carry away the margins of the achenium (as in Parthenium), except a bit at the base. The paleæ are not broad enough to inclose any sterile flowers: those they subtend are deciduous, with the others. Pappus none, except the minute paleaceous tooth at the pointed apex of the achenium. — Distinguished from Euphrosyne by the manifest and almost ligulate corolla of the fertile flowers, the form of the achenium, and the subtending lateral paleæ, &c.; from Parthenium by the less ligulate and deciduous ray-corollas, the reduction of the paleæ of the disk to minute rudiments, and the want of a pappus.

Ambrosia psilostachya, *DC. Prodr. 5. p. 526; Gray, Pl. Wright. adn. p. 104.* Low banks of the San Pedro, Sonora; Sept. (1209.)

Franseria tenuifolia, var. tripinnatifida, *Gray, Pl. Lindh. 2. p. 227, & Pl. Wright. l. c.* Alluvial prairies of the San Felipe, Western Texas; May (a dwarf form). Cooke's Spring, New Mexico; and in Sonora; Sept., Oct. (1210.)

F. Hookeriana, *Nutt.* Valley west of the Chiricahui Mountains, Sonora; Sept. (1211.)

Hymenoclea monogyra, *Torr. & Gray, Pl. Fendl. p. 79, & Pl. Wright. l. c.* Pebbly bed of a mountain torrent, near Santa Cruz, Sonora; Sept. (1212.) — "Branching from the root, 2 to 5 feet high."

Zinnia tenuiflora, *Jacq. Ic. Rar. 3. t. 590; DC.! Prodr. 5. p. 535.* Z. intermedia, *Engelm. in Wisl. Mem. N. Mex. p. 107.* Hills near Santa Cruz, Sonora; Sept. (1213.) — The specimens well accord with authentic ones of Z. tenuiflora (the name of which is hardly appropriate), and like them are more or less pubescent, and with the peduncles very often neither elongated nor cylindrical.

Z. (Diplothrix) grandiflora, *Nutt.; Gray, Pl. Wright. p. 105.* Live Oak Creek, Western Texas, and between the Limpio and the Rio Grande. (1214.)

Z. (Diplothrix) pumila, *Gray, Pl. Fendl. p. 81, & Pl. Wright. l. c.* Rocky hills near El Paso; March. Heads of the Aqua Prieta, in mountains east of Santa Cruz, Sonora; Oct. (1215.)

Z. (Heterogyne) anomala, var. *Gray, Pl. Wright. l. c. t. 10. f. 2.* Alluvial prairies from Chicon Creek, Western Texas, to the Pecos; May, July. (1216.) — "Flowers dark orange."

Halea Texana, *Gray, Pl. Fendl. p. 83, & Pl. Wright. l. c.* Stony hills, from San Felipe to the San Pedro, Texas; May. (1217.)

Heliopsis parvifolia (sp. nov.): scabrella; caule gracili; foliis lanceolatis vel subhastatis basi paucidentatis (pollicaribus); pedunculis elongatis sub capitulo ampliatis; involucri brevissimi squamis oblongis obtusis; ligulis persistentibus; acheniis

papillosis, disci prismaticis areola acute quadrata. — Hill-sides, between Barbocomori and Santa Cruz, Sonora; Sept. (1218.) — Stem 12 to 18 inches high, very slender, branched. Leaves barely an inch long, 3 to 5 lines wide at the base, which is abruptly contracted into a petiole of 3 or 4 lines in length, mostly obtuse and entire, except near the base. Peduncles 4 to 6 inches long; the apex more or less enlarged and hollow. Involucre 4 lines in diameter. Ligules deep yellow, oblong, half an inch in length, three-toothed at the broad apex. Achenia of the disk acutely quadrangular, the apex square and exactly truncate, with the angles sharp. Ligules persistent, but withering with age.

Lepachys columnaris, var. Tagetes, *Gray, Pl. Wright. p.* 106. Banks of the San Pedro, Western Texas; May. (1219.)

Heliomeris multiflora, *Nutt.; Gray, Pl. Fendl. p.* 84, & *Pl. Wright. p.* 107. Sides of mountains at the copper mines, New Mexico, and near the San Pedro, Sonora; Sept., Oct.: a narrow-leaved form, like Wright's No. 334. (1220.) Also on pine hills between the copper mines and the Mimbres; Oct.: a large and broad-leaved form, like Wright's No. 328. (1221.) — The latter, like the former, has an annual root. The larger leaves are 4 inches long and 6 or 8 lines wide.

H. multiflora, var. hispida. Low, damp soil, near Santa Cruz and San Bernardino, Sonora; Sept. (1222.) — The leaves are linear or narrowly linear-lanceolate, and, like the stems and peduncles, either sparsely, or in young plants very densely, setose-hispid. Some specimens are canescently hispid: others exhibit gradations to the ordinary forms; else I should certainly have characterized the plant as a new species. A cultivated specimen shows that the leaves are thickish, canaliculate above, and with the large and strong midrib very prominent underneath.

H. tenuifolia, *Gray, l. c.* Rocky hills of the San Pedro, Western Texas; May. Near Eagle Springs; June. (1223.)

Simsia exaristata (sp. nov.): annua; caule erecto superne pedunculis petiolisque pilis patentissimis hispido-villosis; foliis ovatis seu oblongo-ovatis acuminatis subserratis hirsutulis longe petiolatis, petiolis exauritis; capitulis corymboso-paniculatis; squamis involucri lanceolatis, exterioribus parce hispidis paullo brevioribus; ligulis 4–7 parvis discum haud superantibus; acheniis glaberrimis omnino calvis vel obsoletissime biaristellatis. — S. lagascæformis, *Gray, Pl. Wright. no.* 331, pro parte. — Valley of a tributary of the San Pedro, Sonora; Sept. (1224.) — Stem mostly slender and rather simple, one to two feet high. Leaves all undivided and almost entire, 2 to 4 inches long, on petioles of 1–2 inches in length, which are not at all auriculate or dilated at the base. Heads 5 or 6 inches in length: the rays very small and inconspicuous, yellow, as are the disk-flowers. Paleæ of the receptacle mostly scarious, pointed. The achenia are like those of S. subaristata, *Gray, Pl. Fendl.*, but more rarely showing any trace whatever of pappus. That species is canescently strigose, with deeply lobed leaves, the petioles auriculate at the base, the heads larger and solitary, and the exterior scales of the involucre as long as the inner, the ligules exserted, &c. I cannot now refer to these specimens of Wright's former collection, distributed under No. 331, which

exhibited awned and silky-pubescent achenia. The specimens preserved in my own herbarium and in that of Mr. Lowell are entirely of the present plant, which has the achenia glabrous and awnless, or rarely with two minute and aristelliform teeth; adding another instance of the want of a pappus in this genus.

S.? (Geræa) scaposa (sp. nov.): cinereo-puberula; caulibus suffruticosis? abbreviatis folia linearia rigidula scabra conferta gerentibus in pedunculum prælongum scapiformem monocephalum productis; involucro fere uniseriale discum æquante, squamis linearibus foliaceis hirsutis laxis; pappi aristis inæqualibus corolla brevioribus undique cum achenio villosissimis. — Stony hills between the Mimbres and the Rio Grande, New Mexico; Oct. — Only four specimens were gathered, and all but one of them with the flowers not yet expanded. The proper stems are only two or three inches long, and very leafy. Leaves alternate, much crowded, sessile, 2 or 3 inches long, one or two lines wide, acutish, rather thick and rigid. cinereous-scabrous, one-nerved, or obscurely three-nerved, somewhat veiny. Scape, or peduncle, 6 to 12 inches long, naked or nearly so. Head half an inch in length. Involucre lax or spreading, many-flowered. Flowers yellow. Ligules broadly obovate or cuneiform, 3-toothed at the apex, half an inch long. Paleæ of the convex receptacle conduplicate around the disk-flowers, membranaceous, a little hairy near the obtuse tip. Disk-flowers nearly as in S. (Geræa) canescens, *Pl. Fendl. p.* 85. Ovaries compressed, very silky-villous. Pappus of two chaffy awns of unequal length; the shorter awn often not longer than the villous hairs of the achenium, both very villous for their whole length. Although different in habit, this plant appears to be congeneric with one which, in *Proceed. Amer. Acad.* 1. *p.* 48, I named Geræa canescens, and subsequently, in *Pl. Fendl. l. c.*, reduced to a subgenus of Simsia. It is, as it were, an Encelia with awns.

Viguiera cordifolia, *Gray, Pl. Wright. p.* 107; var. foliis omnibus breviter sed manifeste petiolatis tantum subcordatis acuminatis. — Valley of Coppermine Creek, New Mexico, growing under trees; Oct. (1225.) — These are better specimens than Wright's No. 332, on which the species was founded, with thinner leaves, all of them on petioles of $1\frac{1}{2}$ to 3 lines in length. The scales of the involucre are lanceolate, the exterior, with their considerable acumination, little shorter than the inner. The awned scales of the pappus are nearly as long as the disk-corolla; the intermediate scales, 2 or 3 on each side, are almost a line in length, oblong, erose-laciniate at the apex, nearly glabrous. Ligules about 8, half an inch long.

V. cordifolia, var. gracilis; foliis minoribus fere membranaceis grosse serratis; involucri squamis æquilongis. — With the foregoing; of which it is evidently a state, growing in more shaded situations.

V. cordifolia, var. foliis amplis (3 – 4 unc. longis $2\frac{1}{2}$ – 3 latis) membranaceis basi vix subcordatis breviter petiolatis. — Sides of a ravine at Santa Cruz, Sonora; Sept. (1226.) — This has the involucre with broader scales, as in No. 332, except that the outer ones are mostly as long as the inner. The leaves are thin, and distinctly petioled. The intermediate paleæ of the pappus are shorter than in No. 1225, commonly 4 or 5 on each side, and either strigose-pubescent or nearly glabrous. I cannot distinguish any of these plants from V. cordifolia; the name of which proves not to have been happily chosen.

V. LAXA, *DC.; Gray, Pl. Wright. p.* 108. V. Texana, *Torr. & Gray, Fl.* 2. *p.* 318. In thickets, valley of the Coppermine Creek, New Mexico; Oct. (1227.) — The large and thin-leaved form of the species. It belongs to De Candolle's first section of the genus, the receptacle, at first convex, becoming truly conical (as well in Berlandier's as in other specimens), as is also noticed by Schauer, in *Linnæa*, 19. *p.* 728. The rays are from 5 to 10 in number.

V. LAXA, *DC.*, fere var. BREVIPES, *Gray, Pl. Wright. l. c.* In a ravine, at Santa Cruz, Sonora; Sept. (1228.) — Leaves either opposite or alternate.

FLOURENSIA CERNUA, *DC. Prodr.* 5. *p.* 593; *Gray, Pl. Wright. p.* 114. Valley of the Pecos, on stony hills; May. Hills between the Mimbres and the Rio Grande; Nov. (1229.)

HELIANTHUS LENTICULARIS, *Dougl. in Bot. Reg. t.* 1265; *Gray, Pl. Fendl. p.* 83. Valley of Coppermine Creek, New Mexico; Aug. and Oct. (1230.)

H. PETIOLARIS, *Nutt.; Torr. & Gray, l. c.* Valley of Coppermine Creek; Oct.: two forms. (1231.)

H. PETIOLARIS, var. CANESCENS, *Gray, Pl. Wright. p.* 108. Valley of the Rio Grande, New Mexico; July. (1232.) — The same as No. 335. — There are also specimens of a more silvery-canescent plant, with the lower leaves broadly deltoid-ovate, as long as their petioles; from the Rio Grande, 40 or 50 miles below El Paso, mentioned in *Pl. Wright.* under No. 335, which I know not what to do with, except to refer them provisionally to the same species. (1232ᵇ.)

H. CILIARIS, *DC. Prodr.* 5. *p.* 587; *Gray, Pl. Wright. p.* 108. Prairies of Turkey Creek, Western Texas; May. (1233.)

H. GROSSE-SERRATUS, *Martens*, var. *γ. Gray, Pl. Wright. l. c.* Valley of the Mimbres, New Mexico; Oct. (Two specimens only.)

ACTINOMERIS LONGIFOLIA (sp. nov.): caule glaberrimo tereti exalato; foliis plerumque alternis (nunc oppositis nunc ternis) subsessilibus lineari-lanceolatis elongatis denticulatis reticulatis utrinque hispidulo-scabris; pedunculis corymbosis scabris monocephalis; involucro biseriali, squamis exterioribus linearibus patulis disco convexo longioribus ligulas subæquantibus, interioribus paleis receptaculi referentibus; acheniis ovalibus alatis calvis vel paucis uniaristatis. — Mountains east of Santa Cruz, Sonora; Sept. (1234.) — Stem 2 feet high, from a perennial root, leafy to the top. Leaves 6 or 7 inches long and 4 to 6 lines wide, a few of them opposite or verticillate in threes, thickish, rough, especially above, acute. Peduncles in a simple corymb, or sometimes solitary. Heads in fruit depressed-globose, and 8 or 9 lines in diameter. Paleæ of the receptacle lanceolate, rather obtuse. Achenia almost 3 lines long, smooth, surrounded by a thickish and rather narrow wing, the outer side of which is sometimes more extended at the emarginate summit. Pappus none, or with minute rudiments of the two awns, or occasionally with one short and naked awn.

A. WRIGHTII, *Gray, Pl. Fendl. p.* 85. Margin of mountain torrents, between the copper mines and Conde's Camp, New Mexico; Aug. (1235.)

COREOPSIS CARDAMINEFOLIA, *Torr. & Gray, Fl.* 2. *p.* 346. Old bed of the Rio Grande, 50 miles below El Paso; June. (1236.)

C. Drummondii, *Torr. & Gray, l. c.* var. *Gray, Pl. Wright. p.* 109. — Prairies of the Leona and Nueces, Texas; May. (1237.) — On rocky hills of the San Pedro, Western Texas, were gathered a few specimens, apparently of this species, with large and remarkably thickened achenia.

Cosmos bipinnatus, var. parviflorus. C. parviflorus, *H. B. K.; DC. Prodr.* 5. *p.* 606. Margin of streams, from Barbocomori towards Santa Cruz, Sonora; Sept.: and on mountains near the copper mines, New Mexico; Oct. (1238.) — This is the same as Fendler's No. 447, 448; but with still smaller ligules (only 3 or 4 lines long, pale rose-color). The scales of the outer involucre are lanceolate, but not narrower than in depauperate specimens of the cultivated C. bipinnatus; they are as long as the inner involucre. Although the exterior achenia are short-beaked, the inner are long-beaked; the beaks scabrous. The awns of the pappus are 2, 3, or occasionally 4.

Thelesperma gracilis, *Gray in Kew Jour. Bot.* 1. *p.* 252, & *Pl. Wright. p.* 109. Hills of the Limpio; June: near Frontera; May: and at the copper mines, New Mexico; Aug. (1239.)

T. filifolia, *Gray, l. c.* Coreopsis filifolia, *Hook. Bot. Mag. t.* 3505. Rocky hills of the San Pedro, and of the San Felipe, Western Texas; May. (1230 bis.)

T. (Abuceros) longipes, *Gray, Pl. Wright. p.* 109. Stony hills of the San Pedro and Pecos, Western Texas; May. (1231 bis.)

Bidens fœniculifolia, *DC. Prodr.* 5. *p.* 603? var. acheniis minoribus ($2\frac{1}{2}$ lin. longis) scabro-hirsutulis. — Valleys of Sonora, between the San Pedro and Sonoita, along streams; Sept. (1232 bis.) Also gathered by Dr. Gregg, at San Antonio de las Alanzanes. — The achenia are linear-oblong, tetragonal, but much obcompressed, and shorter than those of B. fœniculifolia, as characterized by De Candolle; the heads probably smaller. Perhaps it is an undescribed species.

B. heterophylla, *Ort.? DC. Prodr.* 5. *p.* 597? var. caule ramoso; segmentis foliorum (superiorum) fere integerrimis. — Bed of small streams, in mountain valleys, between the San Pedro and Santa Cruz, Sonora; Sept. (1233 bis.) — I am not able to consult Ortega's figure. Our specimens consist of the upper part of branched stems, apparently of a rather tall herb, in flower. The lower cauline leaves present are pinnately 5 – 7-parted, the upper mostly 3-parted, only a few of the uppermost entire: the segments linear, or very narrowly linear-lanceolate, one or two lines wide, the lateral ones 1 – 2 inches, the terminal 2 – $3\frac{1}{2}$ inches, in length, sparingly denticulate-serrate, or nearly entire. Ligules oblong, 6 or 8 lines in length, yellow.

B. bipinnata, *Linn.* Valley of Coppermine Creek, New Mexico. (1234 bis.) — Depauperate forms.

B. heterosperma (sp. nov.): annua, undique glabra; caule ramosissimo ramisque gracilibus; foliis 1 – 2-ternatipartitis, segmentis anguste lincaribus integerrimis nunc 2 – 3-fidis; capitulis paniculatis sparsis breviuscule pedunculatis parvis discoideis; acheniis anguste linearibus tetragonis glabris, extimis brevioribus erostratis aristis 2 brevissimis caducis superatis, interioribus elongatis 2 – 3-aristatis. — Raised from seeds gathered by Mr. Wright near the copper mines, New Mexico. (There

are no dried specimens in the collection.) — Plant a foot or two in height, paniculately or corymbosely much branched, leafy. Leaves one to two inches long, including the short and naked petiole, rarely pinnately 5-parted; the upper usually 3-parted, with the segments either entire or 2 – 3-cleft; the lower ones biternately parted: segments 3 to 12 lines long, and half a line wide. Heads sparsely corymbose-paniculate, 3 lines long, one or two lines wide, rather few-flowered, on peduncles of an inch or less in length. Involucre entirely glabrous; the scales broadly linear, obtuse; the exterior shorter; the inner yellow or yellowish. Exterior achenia 2 lines long, blunt, not broader than the others, their two minute retrosely barbed awns early deciduous: next to these are a few achenia with awns like the innermost, which are 4 or 5 lines long, projecting beyond the disk at maturity, and crowned with two, or sometimes three, retrorsely barbed persistent awns of a line in length.

Heterospermum tagetinum, *Gray, Pl. Fendl. p.* 87, & *Pl. Wright. p.* 110; var. acheniis plerumque omnibus exaristatis. — Mountain-sides at the copper mines; Oct. (1235 bis.) — The lobes of the rather rigid leaves are simple and obscurely and irregularly dotted, as in other plants of this group. Both in the indigenous specimens, and in those raised from their seeds, even the central achenia rarely show even the rudiments of awns. — A few specimens from Ojo de Gavilan have the segments of the leaves often lobed, and the central achenia awned. The want of awns on the short fertile achenia alone distinguishes them, and perhaps not permanently, from H. pinnatum.

Guardiola platyphylla (sp. nov.): glaucescens; foliis brevissime petiolatis ovato-rotundis pl. m. cordatis dentatis triplinerviis; involucro cylindrico, squamis oblongis obtusis; ligulis 1 – 3, tubo glaberrimo, fl. disci 5 – 7; achenio pilosulo. — Hill-sides, along exsiccated streams, between Barbocomori and Santa Cruz, Sonora; Sept. (1236 bis.) — This is an interesting addition to this well-marked genus, of which three species were characterized in *Pl. Wright. p.* 111. I have it also in cultivation, from seeds communicated by Mr. Wright. The terete stems are about 3 feet high, with many corymbose branches. The leaves are pale and more or less glaucous, thickish in texture, rounded, mostly obtuse, mucronate, subcordate or truncate-cordate at the base, repandly and sometimes strongly dentate with callous mucronate teeth. The larger cauline ones are about 3 inches in length and $2\frac{1}{2}$ or more in breadth; the upper and rameal successively smaller, but otherwise similar; the petioles only 1 to 3 lines long. The other species have much longer petioles, and the base of the leaves inclined to be cuneate. Inflorescence, involucre, &c. nearly as in G. Tulocarpus. Involucre about 5 lines long. Ray-flowers not longer than those of the disk, the slender tube shorter: ligule 3 lines long, obscurely 2 – 3-toothed, white, as are the disk-corollas and styles. Anthers green. Fertile achenia nearly 3 lines long, obscurely striate, furnished at the base with a sort of tuberosity or cushion-like enlargement on the back, which cannot be called an adherent scale: in the dried state it shrinks away.

Sanvitalia Aberti, *Gray, Pl. Fendl. p.* 87, & *Pl. Wright. p.* 111. Stony hills and valleys, at the copper mines, New Mexico; Aug. (1237 bis.)

Ximenesia encelioides, *Cav.*, fere δ. cana, *DC.; Gray, Pl. Wright. p.* 112. From Eagle Springs to the Rio Grande below El Paso; June. (1238 bis.)

X. encelioides, var. nana: caulibus depressis vel assurgentibus vix spithamæis; ramis monocephalis; ligulis parvis discum vix superantibus; acheniis dense pubescentibus pachypteris. — Around the dwellings of Prairie-dogs (Pseudostoma Ludoviciana), between the Limpio and the Rio Grande; June. (1407.) — Here this dwarf variety abundantly occurs, unmixed with the ordinary state of the species.

Verbesina podocephala (sp. nov.): humilis, hispida; caulibus herbaceis plurimis e basi suffrutescente simplicibus vel simpliciter ramosis teretibus; foliis oppositis oblongo-ovatis serratis tripli – quintuplinerviis reticulatis basi rotundata subsessilibus haud decurrentibus; pedunculo solitario elongato monocephalo; involucro hemisphærico disco breviore biseriali, squamis ovatis, exterioribus 5 foliaceis obtusissimis laxis, interioribus 10 chartaceis subacutis; ligulis circ. 10 oblongis exsertis; acheniis exalatis, radii triquetris muticis, disci inæqualiter biaristatis vel arista unica abortiva. — Mountain valleys between the San Pedro and the Sonoita, and in a ravine at Santa Cruz, Sonora; Sept. (1239 bis.) — Plant 10 to 20 inches high; the stems hirsute or hispid and scabrous, slender, not at all winged. Leaves rather thin in texture, 2 – 3 inches long, 12 to 20 lines wide, acute or obtuse. Peduncles 6 to 10 inches long. Head nearly half an inch in diameter. Flowers golden-yellow. Ligules linear-oblong, 4 lines in length, usually styliferous and fertile; some of them occasionally sterile or even neutral. Achenia destitute of any coroniform or squamellate pappus: those of the ray obscurely 3-toothed at the angles; of the disk with short and rather stout erect awns. — This is evidently related to V. Capitaneja, *Nees in Linnæa*, 19. *p.* 729, which is only briefly characterized, and is said to have decurrent leaves. Our plant has the aspect of a Gymnolomia, or of a monocephalous Zexmenia, from which the pappus distinguishes it.

Adenophyllum Wrightii (sp. nov.): gracile, scabridum; foliis pinnatipartitis, segmentis 5 – 11 filiformibus inæqualibus muticis; involucro turbinato 8 – 12-dentato haud setigero basi parce subulato-bracteato; floribus flavis; ligulis brevissimis apice bifidis; pappo utroque 10-paleaceo, paleis exterioribus brevibus oblongis, interioribus aristato-trifidis, arista media achenio pubescente æquilonga. — Hill-sides near the copper mines, New Mexico; Oct. (1280.) — Herb a span to a foot high, from an annual root, erect, paniculate-branched, with the aspect of a Dysodia. Leaves with sparse lobes which are not broader than the rhachis, beset with a few large dark glands; the lower opposite, the upper alternate. Peduncles 1 – 2 inches long, furnished with a few subulate bracts; and with 4 or 5 similar ones surrounding the base of the involucre, none of them bristle-bearing. Involucre 3 or 4 lines long, smaller than in Dysodia chrysanthemoides, composed of 8 or the terminal of 10 to 12 lanceolate-oblong glanduliferous scales, which are concreted for three fourths of their length; their membranaceous tips rather obtuse, not awned nor bristle-bearing. Receptacle small, conical, alveolate and fimbrillate. Rays rather shorter than the pappus; the oval ligule shorter than its tube. Lobes of the disk-corolla subulate. Achenia silky-pubescent, or when old glabrate, pentangular. Outer pappus of 10 very short and truncate corneous paleæ, in a single series; the

inner of as many alternate and larger paleæ, cleft beyond the middle into three scabrous awns; the middle awn twice the length of the two lateral. — This plant has more of the habit of Lebetina than of Adenophyllum coccineum. Were the three aristiform segments of the inner pappus again trifid, it would be a true Lebetina. Although the paleæ are twice as numerous as in Adenophyllum coccineum, and deeper cleft, I refer it to that genus because it is the older one, and should consider Lebetina merely as a section of it, resting the character mainly on the double pappus.

Dysodia chrysanthemoides, *Lagasca.* D. fastigiata, *DC.*, excl. syn. Open prairies, on the San Pedro, Sonora; Sept.

Hymenatherum (Aciphyllæa) acerosum, *Gray, Pl. Wright. p.* 115. Stony prairies of San Felipe Creek, Western Texas; hills near El Paso; and around the hot springs between the copper mines and the Mimbres, New Mexico. Also heads of the Aqua Prieta, Sonora. (1241.)

H. pentachætum, *DC.*, var. (= 362, 363) *Gray, Pl. Wright. p.* 117. H. Berlandieri, *DC.* Rocky hills of the San Pedro and Pecos, Western Texas; May, June. (1242.)

H. tenuifolium, *Cass.; Gray, Pl. Wright. p.* 118; var.? ramis brevibus; foliorum lobis paucioribus et longioribus; paleis pappi alternis sæpius minoribus vel minus aristatis paucisve fere muticis. — Stony hills near El Paso; March. (1408.) — An early state probably of H. tenuifolium, with the foliage much as in H. pentachætum; also approaching that species in the tendency to a reduction of the alternate paleæ of the pappus.

H. polychætum, *Gray, l. c.*; var. foliorum lobis linearibus; capitulis paucioribus. — Prairies, from Las Playas to the copper mines, New Mexico; Oct. (1243.) — Mixed with this species, as in the former collection, and so like it as to be overlooked in collecting, I find a single specimen of

Lowellia aurea, *Gray, Pl. Fendl. p.* 91, *& Pl. Wright. p.* 118. — The paleæ of the pappus are about 12 in this specimen.

Tagetes micrantha, *Cav. Ic.* 4. *p.* 31. *t.* 352; *DC. Prodr.* 5. *p.* 646. Mountains around the copper mines, New Mexico; Aug., Oct. (1244.) — "Called *Anis* by the Mexicans." The plant, raised from Mr. Wright's seeds in the Cambridge Botanic Garden, exhales a powerful and pleasant odor of Anise, when bruised. The ligules are white ("albicans," *Cav.*), usually solitary, occasionally two, and rarely three, in each head, only 1½ to 2 lines long, nearly entire, 2 – 3-denticulate or 2-lobed at the apex. Disk-flowers 3 to 8. Pappus of two awns and two broad paleæ; the latter unequal, shorter than the disk-corolla, sometimes connate into a sheath inclosing the awns, which are longer than the corolla.

Chrysactinia Mexicana, *Gray, Pl. Fendl. p.* 93, *& Pl. Wright. p.* 119. Hills at the Big Bend of the San Pedro, Western Texas; May. (1245.)

Porophyllum macrocephalum, *DC. Prodr.* 5. *p.* 648. — Shaded mountain ravines on the Sonoita, Sonora; Sept. (1246.) — The primordial and lower cauline leaves are linear and linear-lanceolate, successively becoming ovate-lanceolate, an inch long. The upper ones are elliptical and broadly oval, 8 or 10 lines long, about the

length of their slender petioles; those of the branches similar, but smaller. There are often a few glands on the face of the leaf, as well as at the obscure repand crenatures. Peduncles, heads, &c. as described by De Candolle; except that the involucre is not quite an inch long, and its scales are scarcely if at all apiculate or mucronate. Achenia pubescent. — This is more closely allied to P. ruderale (which often has pellucid glands on the leaves) than to P. ellipticum.

P. Greggii, *Gray, Pl. Wright. p.* 120. On the Sonoita near Deserted Rancho, Sonora; Sept. Mountain-sides near Lake Santa Maria, Chihuahua; April. (1247.)

P. scoparium, *Gray, Pl. Wright. p.* 119. Rocky hills, near El Paso; May. Painted Caves on the San Pedro; July. (1409.)

Gaillardia pulchella, *Foug.* Prairies from the Mimbres to the copper mines, New Mexico; July. (1248.)

G. pinnatifida, *Torr.* Stony hills of the Pecos; also from El Paso to Doña Ana, and at the copper mines, New Mexico; Aug. (1249.)

Palafoxia Hookeriana, *Torr. & Gray.* Sandy banks of the Rio Grande above Frontera, and below San Elizario; July. (1250.) — A smaller form, but with ample rays.

P. callosa, *Torr. & Gray, Fl. 2. p.* 369. Valley of the Pecos; July. (1410.)

Florestina tripteris, *DC.*, var. *Gray, Pl. Wright. p.* 121. Valley of the Pecos; June. (1251.) — Flowers flesh-color or almost white. The paleæ of the pappus are all very obtuse.

Chænactis stevioides, *Hook. & Arn.; Torr. in Stansbury, Rep. p.* 390. Hills near Camp Fillmore, on the Rio Grande, New Mexico; April. (1411.) — The marginal corollas have a somewhat ampliate limb.

Hymenopappus luteus, *Nutt.; Gray, Pl. Fendl. p.* 97. Stony hills at the copper mines; Aug. (1252.) — The specimens resemble those of Fendler. The scales of the involucre are sometimes tinged with purple at the tips; but the corolla is truly yellow, with the pappus (a line and a half in length) fully as long as its tube.

H. flavescens, *Gray, Pl. Fendl. p.* 97, *& Pl. Wright. p.* 121: — the form with bipinnately-parted leaves, the lobes narrowly linear. — Valley of the Pecos, on stony hills; June. (1253.) The flowers are pale yellow.

H. flavescens, var. cano-tomentosus; foliis 2–3-pinnatipartitis, lobis angusto-linearibus confertis; floribus vero flavis. — Sand-hills near Frontera, New Mexico; April, May. (1412.) — The heads are as bright yellow as in H. luteus; but they are smaller, and corymbose, the paleæ of the pappus shorter and more obovate, and the stems leafy.

H. flavescens, var.? foliis radicalibus et caulinis inferioribus oblanceolatis integerrimis nunc pinnatifidis, lobis majusculis; pappo minore. — Mountain ravine near the Mimbres; Oct. — The root is biennial.

Schkuhria Hopkirkia: capitulis 3–4-floris, flore unico sæpius fœmineo, ligula brevissima imperfecta; acheniis obpyramidatis angulis longe villosissimis; pappi paleis 8 conformibus ovatis extus hirtellis nervo valido excurrente breviter aristatis corollam adæquantibus. — Hopkirkia anthemoidea, *DC. Prodr. 5. p.* 660. — Raised

in the Cambridge Botanic Garden, from seeds collected by Mr. Wright in Sonora. — The cultivated plants are one or two feet high, much branched and bush-like, annual: the cauline leaves pinnately 5 – 7-parted, or the upper 3-parted; the rameal mostly entire, narrowly linear. Involucre somewhat clavate and quadrangular, 3 lines long, nearly equalling the flowers, subtended with one or two small bractlets; the scales 4 or 5, obovate, their scarious tips tinged with purple. Corollas yellow, a line and a half long; those of the hermaphrodite flowers 4 – 5-toothed; that of the solitary female flower when present not longer than the others, and imperfectly ligulate; being 2-lipped, the inner lip small and entire, the outer, or ligule, involute, 2 – 3-toothed at the apex, about the length of the style. Achenia 2 lines in length, more or less villous or glabrate on the four sides, very strongly villous on the angles. Paleæ of the pappus, including the short projecting awn, not longer than the corolla, somewhat erose, the obtuse apex often splitting away from the base of the awn, so as to appear "trifid." — I cannot doubt that this is De Candolle's Hopkirkia, which must be reduced to Schkuhria, as remarked in *Pl. Fendl. p.* 96. The Schkuhria Wislizeni (to which belongs Galeotti's No. 2049), which I there characterized, is to this exactly what S. abrotanoides is to S. octo-aristata; and the following, which I unwillingly characterize as a species, differs only in its rather small, entirely nerveless and awnless pappus.

S. Wrightii (sp. nov.): capitulis 3 – 5-floris, flore unico fœmineo, ligula brevissima imperfecta; acheniis ad angulos villosissimis; pappi paleis 8 obovato-oblongis conformibus enerviis muticis corolla paullo brevioribus. — On the Sonoita near Deserted Rancho, Sonora; Sept. (1254.) — This is to Schkuhria Hopkirkia and S. Wislizeni exactly what S. isopappa, *Benth.* is to S. octo-aristata and S. abrotanoides. It is therefore highly probable that the difference in the pappus, although constant in the specimens, is not of specific importance; and that the three Peruvian species should be viewed as forms of S. abrotanoides, and our three Mexican plants as analogous forms of S. Hopkirkia. S. virgata, *DC.*, with its very unequal pappus and nearly naked achenia, is distinct from either.*

Bahia absinthifolia, *Benth.*, var. dealbata, *Gray, Pl. Wright. p.* 121. Sandy valley in the Mimbres mountains; July: near Frontera; March. (1255.)

B. biternata (sp. nov.): annua, cinereo-puberula; caule erecto gracili superne corymboso-paniculato, ramis oligocephalis; foliis alternis petiolatis biternatisectis, segmentis linearibus obtusis sæpius 2 – 3-lobatis; involucro laxo disco breviore, squamis 12 obovatis obtusis; acheniis hirsutis; pappo e paleis 12 – 14 uninerviis, fl. exteriorum obovatis muticis tubum corollæ adæquantibus, fl. interiorum oblongo-lanceolatis aristatis corolla subdimidio brevioribus. — Gravelly hills near Ojo de Gavilan, New Mexico; Aug. (1256.) — Plant one or two feet high, loosely and paniculately branched; the heads corymbose, on peduncles of an inch or less in length. Segments and lobes of the leaves a line or less in width. Involucre as in B. ambrosioides and B. pedata; the scales about 3 lines in length, membranaceous.

* Achyropappus anthemoides, *H. B. K.* is wholly intermediate between Schkuhria and Bahia, *Lag.*, and will certainly fall into the one or the other genus.

Ligules 8 or 10, broadly obovate, 3-lobed at the apex, bright yellow, as are the numerous disk-flowers. Pappus of the ray and exterior disk-flowers entirely muticous and obtuse, about half the length of the achenium; of the inner disk-flowers, including their rather short scabrous-denticulate awn, almost as long as the achenium. The pappus of some of the intermediate flowers is intermediate in character. — This plant so much resembles Bahia pedata, No. 387 of Wright's former collection, that I was about to pass it as a variety of that species, with more dissected leaves, when I observed the elongated and awned paleæ of the pappus of all the inner flowers. This is an anomaly in the genus: none of the species except B. pedata show even a manifest midnerve to the pappus.

B. PEDATA, *Gray, Pl. Wright. p.* 123. Hills between the Limpio and Ojo de Leon; June. (The original specimens, No. 387, were gathered on the Limpio.) — The few specimens collected the present season are stouter than those of 1840; the leaves with larger, broader, and more incised or lobed segments. It still more resembles the following plant; from which the obtuse and fewer scales of the involucre, as well as the pappus, distinguish it.

VILLANOVA CHRYSANTHEMOIDES: puberula, glabella; caule erecto superne paniculato; ramis floridis pedunculisque subcorymbosis viscoso-glandulosis; foliis alternis 1 – 2-ternatipartitis, segmentis 2 – 3-lobatis seu pinnatifidis, lobis oblongis vel sublinearibus obtusis; involucri squamis subtriseriatis æqualibus acuminatis; ligulis 16 – 20 ovali-oblongis; fl. disci multis. — Amauria? dissecta, *Gray, Pl. Fendl. p.* 104. — Sides of mountains, at the copper mines, New Mexico; Oct. (1257.) — Stems one to four feet high. Leaves all alternate; the larger ones 2 to 4 inches in diameter, glabrous or nearly so. Heads half an inch in diameter, exclusive of the ligules, which are 5 lines long. Flowers all yellow. Scales of the involucre 16 to 20, herbaceous; the exterior lanceolate; the inner oblong-obovate and conspicuously acuminate. Corollas, especially the tube, beset with very glandular short hairs. Branches of the style in the disk-flowers tipped with a short and obtuse cone. Receptacle rather convex. Achenia quadrangular, subclavate, nearly glabrous, striate, all fertile. — This plant is to Bahia proper what the original species of Villanova are to Achyropappus. There is nothing but a larger number of flowers in the head to distinguish it from Villanova, with which it accords very well in habit.

AMBLYOLEPIS SETIGERA, *DC. Prodr.* 5. *p.* 668; *Gray, Pl. Wright. p.* 121. Prairies of the Leona, Western Texas; May. (1258.)

RIDDELLIA TAGETINA, *Nutt.; Torr. in Emory, Rep. t.* 5; *Gray, Pl. Fendl. p.* 93. Alluvial soil along the San Pedro, Western Texas; May. (1259.)

ACTINELLA RICHARDSONII, *Nutt.; Torr. & Gray, Fl.* 2. *p.* 381; *Gray, Pl. Fendl. p.* 101. Stony hills at the copper mines, New Mexico; Aug. (1260.)*

* On the Mimbres, in the spring of 1851, Dr. J. M. Bigelow gathered specimens of Actinella argentea, *Gray, Pl. Fendl. p.* 100. In the same region he likewise discovered another well-marked species, viz.: —

ACTINELLA BIGELOVII (sp. nov.): caulescens, floccoso-lanata, demum glabrescens; caulibus e rhizomate perenni erectis simplicibus striatis apice longe aphyllis scabris monocephalis; foliis angustissime

A. ODORATA, *Gray, Pl. Fendl. l. c., & Pl. Wright. p.* 122. Along the Rio Grande near El Paso; May, in flower; July, in fruit. (1261.)

A. SCAPOSA, *Nutt.; Torr. & Gray, Fl. 2. p.* 382: the villous form. Stony prairies, near Rock Creek and Escondido Springs; June. (1262.)

A. LINEARIFOLIA, *Torr. & Gray, l. c.* Rocky hills along the Pecos, and at Escondido Springs; June. (1263.)

A. LINEARIFOLIA, var. caule elatiore (ultrapedali) strictiore. — Prairies of the Leona, Western Texas; May. (1264.)

HYMENOTHRIX WISLIZENI, *Gray, Pl. Fendl. p.* 102, *adnot.* Valley of the Sierra de los Animos, south of the copper mines, New Mexico; Oct. (1265.) "Also common in Sonora." — The specimens well accord with that of Wislizenus. I think the root is perennial. The disk-corollas are moderately 5-lobed; the anthers partly exserted, and yellow, like the flowers. The achenia are 4–5-angled, and minutely hairy. The pappus is correctly described in *Pl. Fendl. l. c.*, except that the paleate portion is mostly rather longer than the awn. — The following plant, with the involucre and pappus of Hymenothrix, might well claim the rank of a genus, on account of its rayless capitula, with the limb of the corolla parted to the base.

H.? WRIGHTII (sp. nov.): floribus purpurascentibus; ligulis nullis; corollis fl. hermaphroditis limbo 5-partito, lobis oblongo-linearibus; acheniis villosis; paleis pappi 15–18 lanceolatis nervo valido in aristam breviusculum desinente; foliis inferioribus 2–3-ternatisectis, superioribus trisectis segmentis lineari-filiformibus integerrimis. — On hills between the Barbocomori and Santa Cruz, and on the side of the Chiricahui Mountains, Sonora; Sept. (1266.) — Root perennial. Stems glabrous, rigid, corymbosely branched, 2 or 3 feet high. Lower leaves biternately divided and more or less hirsute; the others glabrous: segments of the upper leaves an inch or more in length, and less than a line in width. Peduncles or branches of the loose corymb glandular, or entirely glabrous. Heads 4 or 5 lines in length, about 30-flowered. Involucre shorter than the disk, glabrous, biserial; the exterior scales 4 or 5, linear and smaller; the inner about 7, obovate or oblong, partly scarious, tinged with purple. Corolla pale purple; the limb 5-parted nearly to the summit of the glandular tube; the lobes oblong-linear, spreading, a line and a half in length, equal, or in some of the marginal flowers more or less irregular from the partial union of two of the lobes. Anthers purple, wholly exserted, tipped with an ovate appendage, bidentate at the base. Branches of the style flat, linear, like those of H. Wislizeni, except that the conical appendage is subulate-pointed. Receptacle small and nearly flat, tuberculate, naked. Achenia quadrangular, tapering to the base, villous. Puppus rather longer than the achenia, shorter than

linearibus rigidis integerrimis paucisve caulinis trilobis; involucri squamis oblongo-lanceolatis acuminatis, interioribus acuminatissimis inferne scarioso-marginatis; pappi paleis lanceolatis sensim aristato-acuminatissimis (nervo evanido) corollam disci subæquantibus. — On mountains near the copper mines, and near the Mimbres, New Mexico; April, June. — Stems slender, 8 to 12 inches high. Radical leaves cæspitose, 2 to 3 inches long, barely a line wide, the cauline several on the lower half of the stem, similar, or some of the larger ones furnished with a short lobe on each side above the middle. Head and ligules nearly as large as those of A. argentea. Paleæ of the pappus 3 lines long.

the corolla, composed of 15 to 18 linear-lanceolate hyaline paleæ (which are broader than in H. Wislizeni), with a very strong hispid midrib, produced at the apex into a short hispid-barbellate awn. The aspect of the heads in fruit is something like those of Petalostemon corymbosum.

Galinsoga parviflora, *Cav.*, var. Caracasana. Vargasia Caracasana, *DC. Prodr.* 5. *p.* 676. Valley of Coppermine Creek, New Mexico; Aug., Oct. (1267.) — The achenia of the ray are slighly hairy near the summit, and furnished with a very small setiform pappus, as De Candolle characterized Vargasia, much more reduced than in the figure in *Deless. Ic. Sel.* 4. *t.* 47.

G. parviflora, var. semicalva: acheniis radii glaberrimis calvis. — Side of mountains, at the copper mines; Oct. (1268.)*

Baileya multiradiata, *Harv. & Gray, Pl. Fendl. p.* 106; *Torr. in Emory, Rep. p.* 144. *t.* 6. Valleys between Eagle Springs and the Rio Grande; and on the Mimbres; July. Near El Paso, abundant; April, May. (1269.)

B. pleniradiata, *Harv. & Gray, l. c.* Valleys west of Chiricahui Mountains, Sonora; Sept. (1270.)

Achillea Millefolium, *Linn.* Mountain ravine near the Mimbres; Oct. (1271.)

Artemisia dracunculoides, *Pursh.; Gray, Pl. Wright. p.* 124. Hills, around the copper mines, New Mexico; Oct. (1272.)

A. filifolia, *Torr.* Valley of Coppermine Creek; Oct. (1273.)

A. Canadensis, *Michx.; Torr. & Gray, Fl.* 2. *p.* 417. Hills and valleys around the copper mines; Aug., in flower; Oct., in fruit. (1274.) — A form with the radical leaves canescent.

A. Ludoviciana, *Nutt.; Torr. & Gray, l. c.* Side of mountains at the copper-mines; Oct. Also on mountains near Conde's Camp; Sept. (1275.) Also a small-leaved and very canescent form, like Wright's No. 391. (1276.)

A. Ludoviciana, var. foliis lobisve lineari-lanceolatis supra glabratis. — Valleys near the copper mines; Oct. (1277.) — A form resembling Lindheimer's No. 442, and approaching that called A. Mexicana.

A. Ludoviciana, var. Mexicana, forma tenuifolia. — Mountains around the copper mines; Oct. (1278.) — Lobes of the leaves finer, and the involucre less pubescent, than in Lindheimer's No. 444, which I cannot specifically distinguish from A. Ludoviciana. — Collected with the above is a plant with similar and canescent leaves on the sterile shoots; but those of the fertile stems glabrate, pinnately 3 5-parted, with the lobes and rhachis nearly filiform. (1279.)

Gnaphalium palustre, *Nutt.; Torr. & Gray, Fl.* 2. *p.* 427. Sandy banks of the Rio Grande above El Paso; July. (1280.)

* The following is a New Mexican representative of a Californian and Oregon genus: —

Layia (Madaroglossa) Neo-Mexicana (sp. nov.): hispida, parce glandulosa; foliis linearibus integerrimis; ligulis trifidis albis; acheniis radii pappo parvo paleaceo subdimidiato laciniato coronatis, disci parce pilosis; cæt. fere L. glandulosæ. — Near Santa Barbara, New Mexico, Aug., *Dr. J. M. Bigelow.* (Communicated by Dr. Torrey.) — This might, perhaps, have been taken for Layia glandulosa, if it were not for the constant presence of a pappus in the ray-flowers; in which respect it differs not only from the rest of the genus, but from the sole distinguishing character of the division *Madieæ.* The character of the genus and of the section Madaroglossa must accordingly be extended in this particular.

G. LUTEO-ALBUM, *Linn.* Sandy bars of the Nueces, Texas; also on the Pecos, and the Rio Grande, near El Paso. (1281.)

G. SPRENGELII, *Hook. & Arn.; Gray, Pl. Wright. p.* 124. Hills, near Cooke's Spring, between the Rio Grande and the Mimbres; Nov. (1282.) — Also (a large form) on hills around the copper mines (1283), and in valleys of Sonora (1284).

G. MICROCEPHALUM, *Nutt.; Gray, Pl. Wright. p.* 124. Mountains near the copper mines: a single specimen only gathered.

G. LEUCOCEPHALUM (sp. nov.): caulibus e basi herbacea plurimis erectis simplicibus cano-lanatis; foliis anguste linearibus acutissimis basi breviter decurrentibus supra viridibus pube brevissima subglandulosa scabridis subtus cano-lanatis; capitulis in corymbum densum polycephalum congestis; involucri campanulati squamis (basi angustata tomentosa exclusa) ovatis oblongisve obtusis glabris candidis. — G. polycephalum, *Gray, Pl. Wright. p.* 124. *no.* 393, non *Michx.* — Bed of mountain torrents near Santa Cruz, Sonora; Sept. (1285.) — Stems one or two feet high, leafy to the top, puberulent-glandular under the coat of wool, terminated by a dense compound corymb. Leaves 2 or 3 inches long, only a line and a half wide, about the same breadth at the manifestly decurrent base. Heads more than 50-flowered, the hermaphrodite flowers few in the centre. Involucre 3 lines in length and breadth; the scales bright white, all (except perhaps the outermost) obtuse. — This is manifestly different from G. polycephalum, to which I wrongly referred the specimens gathered in 1849. It is more closely related to G. leptophyllum, which has straw-colored or fuscous and lanceolate scales of the involucre.

CACALIA DECOMPOSITA (sp. nov.): glabrata; caule longe subaphyllo apice corymboso polycephalo; foliis 3 – 4-pinnatisectis, segmentis linearibus; petiolo basi vaginante; involucro 5 – 6-phyllo 5 – 6-floro basi vix bracteolato; pappo corollam subæquante. — Mountains, east of Santa Cruz, Sonora; Sept. (1286.) — Stem 3 feet high, terete, floccose-woolly at the base and at the base of the petioles, otherwise nearly glabrous, bearing one or two very large leaves (6 – 12 inches long and little less broad) at the base, naked above, or with one or two small but similarly dissected leaves, those which subtend the branches of the compound corymb reduced to bracts. Segments of the leaves 6 to 18 lines long, a line to a line and a half wide, entire, or with one or two lobes; the rhachis not toothed. Pedicels pubescent. Heads half an inch long; the involucre about half that length. Achenia thick. Corolla apparently flesh-color.

SENECIO LOBATUS, *Pers.; Torr. & Gray, Fl.* 2. *p.* 437. Banks of the Rio Grande, near El Paso; and banks of the Rio Santa Maria, Chihuahua; April, May. (1413.)

S. TAMPICANUS, *DC. Prodr.* 6. *p.* 427; *Gray, Pl. Wright. p.* 125. Hills on the Limpio; June. (1287.)

S. FILIFOLIUS, *Nutt. β.* FREMONTI, *Torr. & Gray, Fl.* 2. *p.* 444. Stony prairies of the Leona and Nueces, Texas; May. (1288.)

S. LONGILOBUS, *Benth.*, var. floccoso-lanatus, mox glabrescens. — Valley of the Rio Grande, near El Paso; April. (1414.) — Between No. 399 and No. 400.

S. FASTIGIATUS, *Nutt.; Torr. & Gray, l. c.* Ravines between the copper mines and the Mimbres, New Mexico; Oct. (1289.) — A low form, exactly agreeing

with a specimen from Nuttall, except that the cauline leaves are repandly toothed in several specimens. It probably passes into S. canus, *Hook.*

S. AUREUS, *Linn.*, var. BOREALIS, *Torr. & Gray, Fl. l. c.*, verging towards a stout and floccose form of var. Balsamitæ (S. Plattensis, *Nutt.*). Sides of the Organ Mountains, northeast of El Paso; April. (1415.)

PSATHYROTES SCAPOSA (sp. nov.): spithamæa, arachnoideo-lanuginosa; foliis fere omnibus radicalibus rotundo-ovatis subcrenatis basi trinerviis petiolatis; scapo glanduloso sæpe diviso 2–10-cephalo; involucri multiflori squamis estriatis oblongo-lanceolatis. (Tab. XIII.) — Stony hills above El Paso; May: also near Lake Santa Maria; April. (1416.) — Root slender, biennial or annual, producing from one to several scapes or nearly leafless flowering stems, from 3 to 6 inches high, which are glandular and viscid, as are the peduncles and heads. Leaves all radical, or approximated on very short and forking stems (the subcauline ones alternate), 6 to 18 lines long, obtuse, obscurely or irregularly crenate, or entire, abruptly contracted into a petiole as long as the blade, clothed, as well as the base of the stem, with a loose and white arachnoid tomentum, which is partially deciduous with age, under which the surface is more or less viscid. Bracts, subtending the peduncles or branches of the scape, inconspicuous and linear, one or two lines long. Heads subcorymbose, 4 lines long. Involucre of about 16 equal oblong-lanceolate scales, which are nearly in a single series, membranaceous but greenish, flat, not striate, obscurely veiny by transmitted light, rather obtuse, viscid-pubescent, shorter than the flowers. Receptacle nearly flat, naked. Flowers 30 to 40, all similar and tubular; the corolla light yellow, viscid. Style nearly as in Arnica. Achenia turbinate, obscurely pentangular, villous. Pappus shorter than the achenia, and only about half the length of the corolla, fine and capillary, copious, the bristles very unequal in length, rather rigid, scarcely at all denticulate even under a strong lens, persistent. — In *Plantæ Wrightianæ*, *p.* 86, among the species to be excluded from Brickellia, the Bulbostylis annua of Nuttall is mentioned as an obscure plant of uncertain genus, either of Asteroideæ or Senecionideæ. Of it I have seen only a poor specimen in the Hookerian herbarium, from which I took some florets for examination; which show that it and the plant now under consideration are undoubted congeners. As they cannot be associated with any genus known to me, I merely raise to generic rank the section under which Nuttall characterized his Bulbostylis annua, changing a single letter in the termination of the name, that it may correspond to the Greek word (*ψαθυρότης*) from which he derived it.* The

* PSATHYROTES. (Bulbostylis § Psathyrotus, *Nutt.*)

Capitulum homogamum multiflorum; floribus tubulosis. Involucrum 1–2-seriale, squamis æqualibus. Receptaculum nudum, fere planum. Corolla cylindraceo-infundibularis, tubo proprio brevissimo, limbo 5-dentato. Antheræ elongatæ, demum exsertæ, ecaudatæ. Styli rami subcompressi, lineis stigmaticis obscuris percursi, extus hirtelli, cono inconspicuo terminati. Achenia oblongo-turbinata, villosa. Pappus pilosus, corolla dimidio brevior, parum copiosus; setis tenuibus rigidulis vix scabris valde inæqualibus. — Herbæ Neo-Mexicanæ monocarpicæ, nanæ, glanduloso-viscosæ; foliis alternis ovatis vel cuneatis; floribus pallide flavis.

1. P. ANNUA. Bulbostylis (Psathyrotus) annua, *Nutt. in Jour. Acad. Philad. n. ser.* 1. *p.* 179.
2. P. SCAPOSA. Vide supra.

name has no particular applicability to the present species (the stems of which are by no means brittle or fragile), nor apparently to Nuttall's plant either. The genus may be provisionally referred, I think, to the Senecionideæ of the subtribe Senecioneæ.

Cirsium Wrightii (sp. nov.): caule elato (3–9-pedali) superne corymboso-paniculato polycephalo; foliis cum ramis utrinque tenuiter arachnoideo-lanuginosis demum glabrescentibus, radicalibus magnis profunde pinnatifidis in petiolum superne lobulatum inferne spinosum attenuatis, caulinis pinnatifido-sinuatis basi attenuatis in caulem leviter decurrentibus dentibus marginibusque spinulosis, ramealibus parvis sensim ad bracteas subulatas reductis; capitulis nudis parvulis; involucri hemisphærici squamis subulatis appressis cuspidato-apiculatis; corollis carneis vel ochroleucis. — C. altissimum, var. *Gray, Pl. Wright. p.* 125. *no.* 406. — Around springs near San Bernardino, on the borders of New Mexico and Sonora; Oct. (1290.) — A tall species, which in the former collection I took for a variety of C. altissimum. From that it obviously differs in the thin and cobwebby, and rather deciduous pubescence, the naked peduncles and heads, as well as in the shorter and hemispherical involucre, the scales of which are barely callous-pointed, but not spinescent. It should stand next to C. muticum, which has a differently shaped involucre, with broader and blunter scales, shorter peduncles, more divided leaves, &c. The radical leaves of C. Wrightii are about two feet long; the cauline a foot or more in length; those of the flowering branches one or two inches, or still smaller. Heads barely an inch in length.

C. Virginianum, *Michx.* var. γ. *Torr. & Gray, Fl.* 2. *p.* 458. Low and grassy flats around Escondido Springs, between the Pecos and the Limpio; June. (1291.)

C. undulatum, *Spreng.; Torr. & Gray, l. c.; Gray, Pl. Wright. p.* 125. Prairies from Howard's Creek, Western Texas, to the Limpio; May. (1292.) — Two or three forms. One or two very spinose specimens make a transition to C. ochrocentrum. Also, with smaller heads, on Coppermine Creek; Oct. (1293.) Another variety, with numerous lanceolate lobes to the elongated leaves, was gathered between the Barbocomori and Santa Cruz, Sonora. (1294.)

C. ochrocentrum, *Gray, Pl. Fendl. p.* 110. Sandy banks of the Rio Grande above Doña Ana; Sept. (1295.) — The leaves are perfectly crowded with long, yellowish spines, and similar spines tip the scales of the involucre. Yet I fear it is only an extreme form of the polymorphous C. undulatum.

C. Neo-Mexicanum (sp. nov.): foliis lanceolatis seu oblongo-linearibus sinuato-pinnatifidis spinosis utrinque cauleque arachnoideo-lanatis incanis, caulinis basi angusta spinosa decurrentibus, radicalibus subpetiolatis; capitulis solitariis vel subcorymbosis subglobosis erectis; involucro arachnoideo-lanato, squamis lanceolatis, exterioribus apice foliaceo patulo vel recurvo in spinam subulato-productis, intimis linearibus acuminatis fere inermibus. (C. canescens, *Gray, Pl. Fendl. p.* 110? haud *Nutt.*, is probably a variety of this, with smaller and more numerous heads, and less spreading involucral scales.) — Side of the Organ Mountains, northeast of El Paso; April. (1417.) — "Stem 2–4 feet high, somewhat branching"; the branches

usually monocephalous. The whole plant is covered with a white wool, which is looser and more arachnoid than in C. undulatum; and the upper surface is found to be smooth when the woolly covering is rubbed off. The involucre, also loosely woolly, is about an inch and a half in diameter, not bracteate; the scales with a chartaceous or coriaceous and appressed base; and all but the innermost with a foliaceous-acuminate and spine-tipped entire appendage, which is widely spreading, or the exterior scales reflexed. This should be compared with Cirsium Mexicanum, *DC.* (but it is wholly unlike C. lanceolatum) and with C. cernuam, *Lag.* The involucre most resembles that of C. heterolepis, *Benth.* (to which belongs, I believe, No. 467 of Coulter's Mexican collection), but it is smaller and less foliaceous.

C. Grahami (sp. nov.): caule 3 – 5-pedali apice parce ramoso; ramis monocephalis; foliis subtus cano-lanuginosis supra leviter arachnoideis mox nudis minute viscoso-hirtellis lanceolatis sinuatis vel subpinnatifidis spinuloso-ciliatis lobis dentibusve breviter spinosis, caulinis semiamplexicaulibus haud decurrentibus; involucro subgloboso basi bracteolis 2 – 3 parvis instructo, squamis coriaceis appressis glabratis lanceolatis spinula brevissima apiculatis; corollis intense purpureis. — Low grounds, in valleys between the Sonoita and the San Pedro, Sonora; Sept. (1296.) — Radical leaves over a foot in length and three inches wide; those of the elongated flowering branches one to three inches long; the uppermost linear. Head an inch and a half in length. Scales of the involucre barely spinulose-mucronate or cuspidate. Flowers very bright and deep purple. The nearly muticous involucre, the deep purple flowers, and the leaves bare and green above, principally distinguish this from some forms of C. undulatum, which moreover grows in high and dry ground. It is named in honor of Col. J. D. Graham, under whose auspices the collection was made.

Perezia runcinata, *Lagasca; Gray, Pl. Wright. p.* 125. Stony hills of the Pecos and San Felipe Creek, Texas; May, July. (1297.)

P. nana, *Gray, Pl. Fendl. p.* 111, *& Pl. Wright. l. c.* Along branches of the San Pedro, Sonora; Sept. Stony hills, near El Paso; March. (1418.) — "Plant very sweet-scented in drying."

P. Wrightii, *Gray, Pl. Wright. p.* 127. Prairies along the Rio Frio, Western Texas; May. (1298.)

Trixis angustifolia, *DC. Prodr.* 7. *p.* 69; *Gray, Pl. Wright. p.* 128; var. foliis lato-lanceolatis sæpe denticulatis. — Ravines, at Santa Cruz, Sonora; Sept. Mountains near El Paso; May. (1299.) — The leaves are very much wider than in Gregg's specimens; those of Wright's former collection are intermediate in their form.

Leria nutans, *DC. Prodr.* 7. *p.* 42. Comanche Creek, Western Texas; May.

Calais linearifolia, *DC.; Torr. & Gray, Fl.* 2. *p.* 471. Shore of Lake Gusman, Chihuahua. Also sandy hills, Camp Fillmore, and on the adjacent Organ Mountains, New Mexico; April. (1419.) — The specimens accord well with the Californian plant, except that the scales of the involucre are scarcely so much acuminate, and the achenia rather less beaked; — differences which do not appear to

be of specific importance. As in the Californian plant, the leaves are either glabrous or pubescent; and either entire, or with a few spreading teeth, or laciniate-pinnatifid. In some of the exterior, chiefly sterile flowers, the awns of the pappus are as long as the palea.*

Pinaropappus roseus, *Less.*, *DC. Prodr.* 7. *p.* 99. Stony hills of the San Felipe, Western Texas. (1420.)

Rafinesquia Neo-Mexicana (sp. nov.): humilis; foliis runcinato-pinnatifidis; involucri squamis propriis 7 – 8 lanceolatis uniseriatis; acheniis breviuscule rostratis, exterioribus cinereo-pubescentibus, intimis glabris; pappo albo, setis rigidulis. — Stony hills along the Rio Grande near El Paso, abundant; March, April. (1421.) — Plant from 3 to 12 inches high, branching, from a slender monocarpic root (which probably originated from the seed late in the autumn previous), rather slender, entirely glabrous. Leaves slightly fleshy, one to two inches long; the radical obovate or oblong, barely toothed; the cauline lanceolate or linear, auriculate-clasping at the base, and pinnatifid, with few or several oblong or linear spreading or somewhat recurved lobes; the uppermost linear and entire, gradually reduced to small bracts. Heads solitary, terminating the branches. Involucre an inch long, cylindraceous, tapering upwards, or elongated-conical, composed of about 10 short ovate-acuminate calyculate scales, and of 7 or 8 elongated lanceolate membranaceous scales, tapering to a point, as long as the disk; all somewhat united and thickened at the base. Receptacle flat, naked, areolate. Flowers from 15 to 18, all fertile and similar. Ligules rose-color, or nearly white above and purple underneath. Achenia terete, obscurely 5-ribbed, tapering from the base (the large areola of insertion basilar) upwards, and prolonged into a not very slender beak, which is about half the length of the body of the achenium; the exterior canescently pubescent; the innermost glabrous and smooth, or very nearly so. Pappus bright white, composed of 10 or 12 rather rigid setæ (like those of Scorzonera), about the length of the achenium, and conspicuously and densely plumose from the base to a little below the capillary apex. — This handsome vernal plant appears to be a genuine congener of the Rafinesquia Californica of Nuttall, notwithstanding the shorter and stouter beak to the fruit, and stronger, more paleolate bristles of the pappus.

Stephanomeria minor, *Nutt.; Gray, Pl. Wright. p.* 128. Alluvial soil on the Pecos; June. (1300.)

S. runcinata, *Nutt.; Gray, Pl. Fendl. p.* 112. Jamesia pauciflora, *Nees! in Neuwied Trav. App. p.* 16. Hills near El Paso; May. (1422.) — "Flowers purple."

S. runcinata, *Nutt.*, var. caulibus elatioribus (1 – 2-pedalibus); ramis paniculatis; foliis tenuioribus. — Pebbly bed of Howard's Creek, Western Texas; May. (1301.)

* Hymenonema? glaucum, *Hook. Fl. Bor.-Am.* I. *p.* 300, judging from the imperfect original specimen, is not the Calais macrochæta, *Gray, Pl. Fendl.*; but a Scorzonella; perhaps the entire-leaved state of S. laciniata.

CALYCOSERIS, *Nov. Gen.*

Capitulum liguliflorum multiflorum. Involucrum campanulatum, duplex, interius e squamis circa 12 lineari-lanceolatis margine scariosis subuniseriatis; exterius calyculiforme, e squamis totidem brevibus laxis. Receptaculum planum, paleis tenuissimis piliformibus inter flores onustum. Achenia conformia, fusiformia, crasse 5 – 6-costata, muricato-scabra, apice attenuato-rostrata. Pappus duplex; exterior coroniformis persistens; interior pilosus, copiosus, setis mollibus niveis vix scabris basi in annulum concretis caducis. — Herba monocarpica, humilis, glabra; caule a basi ramoso; foliis pinnatipartitis, lobis rhachique linearibus; pedunculis breviusculis monocephalis ante anthesin nutantibus cum involucri basi hispido-glandulosis; floribus roseis.

Calycoseris Wrightii. (Tab. XIV.) — Stony hills around El Paso, abundant; March, April. (1423.) — Plant about a span high, from a slender simple root, branched from the base; the branches or stems ascending, sparsely leafy, sparingly setose-glandular towards the summit. Leaves glaucescent, linear, and with few or several spreading linear lobes from 2 to 5 lines in length; the terminal lobe prolonged. Involucre half an inch long, externally sparsely beset, like the peduncle, with nail-headed glandular setæ. Ligules pale rose-color, marked with deeper purple underneath, half an inch long. Receptacle flat, about 25-flowered, areolate, each flower subtended by a delicate capillary bristle in place of a palea: these bristles, which may perhaps be compared with those of the receptacle of Andryala, are persistent, though rather fragile, and as long as the achenia. Achenia all alike, $2\frac{1}{2}$ lines long, terete, with 5 or 6 broad ribs separated by narrow grooves, tuberculate-roughened, tapering gradually into a thickish beak which is rather shorter than the body of the achenium, its dilated apex crowned with the hyaline crateriform outer pappus, the edge of which is even, but multidenticulate. Inner pappus pilose, bright white, consisting of copious and equal, scarcely denticulate, soft bristles, all rather firmly united into a ring at the base and deciduous together. — This well-marked genus (as well as Anisocoma, *Torr. & Gray in Bost. Jour. Nat. Hist.* 5. *t.* 13, which agrees with it in having an exterior coroniform pappus) will hardly find a place in any of De Candolle's subtribes, as they now stand. Disregarding this peculiar character of the pappus, Calycoseris would fall into Rodigieæ, if the setæ of the receptacle be taken for true paleæ. But if they are of the same nature as those of Andryala, the genus might be placed near Crepis and Malacothrix. However, it is hardly worth while to speculate upon its appropriate place until the whole tribe has undergone revision.

Malacothrix Fendleri: nana, glabrata; caulibus e radice exili plurimis diffusis; foliis junioribus parce arachnoideis, radicalibus runcinato-pinnatifidis dentatisve lobis cuspidato-mucronatis, caulinis paucis linearibus, summis integerrimis; acheniis fere cylindricis æqualiter multicostatis apice manifeste cupulato integerrimo; pappi seta unico validiore lævi subpersistente, cæteris scabris inferne barbellulatis caducis. — M. sonchoides, *Gray, Pl. Fendl. p.* 113, non *Torr. & Gray.* — Stony hills around El Paso, &c., abundant; March, April. (1424.) — The habit

and aspect of this plant are almost exactly as in M. sonchoides, with which I formerly confounded it. That species, however, as stated by Dr. Torrey (*Appendix to Stansbury's Report*, p. 392), has five stronger and persistent bristles to the pappus. The achenium, moreover, is strongly angled with five thick and equidistant ribs, which are much larger than the others (two in each interval), and alternating with the stronger setæ of the pappus; and its apex is very minutely denticulate, but not produced into a cup or distinct border. In M. Fendleri, the ribs of the brownish achenium are slender and all alike, and its apex is continued into a decided cup, with an even edge, within which the row of minute denticuli, like persistent bases of the setæ of the pappus, are concealed; and only one (sometimes two?) of the rays of the pappus is stronger and persistent. — The Californian plant of Coulter's collection, which I also inadvertently referred to M. sonchoides, is doubtless M. obtusa, *Benth.*; likewise gathered by Dr. Parry, at Monterey. In this the achenia, in Parry's specimens, are tapering to the base, somewhat angled, but evenly multistriate, and with scarcely any apical border; the pappus is wholly deciduous in a ring; and I find no stronger and naked bristles. — Dr. Torrey indicated to me an analogous structure in the pappus of Sonchus, in which four or five of the inner bristles of the pappus are much stronger than the soft and delicate exterior pappus. This, I find, has been duly noticed by C. H. Schultz, in the *Phytographia Canariensis* of Mr. Webb.

Prenanthes? exigua (sp. nov.): caule 3–4-pollicari ramosissimo; pedunculis divaricatis; foliis radicalibus caulinisque oblongis vel obovatis basi attenuatis spinuloso-dentatis nunc sinuatis, ramealibus ad bracteas minimas reductis; involucro tetraphyllo quadrifloro; acheniis 5-sulcatis scabriusculis pappo rigido sublongioribus. — Stony hills above El Paso; April. (1425.) — Root simple, annual or biennial. Leaves 6 to 10 lines long, glabrous. Stem soon deliquescent into a diffuse and corymbose compound panicle. Involucre 2 lines long, subtended by a minute bract, like those of the peduncles and branchlets; the scales oblong-lanceolate. Ligules short; the color not known, probably flesh-colored. Achenia cylindrical, scarcely narrowed at the base, truncate at the apex, the surface occupied by five very broad and flat ribs, separated by narrow grooves, minutely scabrous. Pappus bright white, of copious and very unequal bristles, which are unusually stiff and rigid, slightly thickened downwards, minutely scabrous, the smallest less than half the length of the longest, and these rather shorter than the achenium, at length separating in a ring. This plant seems to fall more readily into Prenanthes than into any other genus known to me; but it may not be a true congener of the European species.

Lygodesmia aphylla, var. Texana, *Torr. & Gray, Fl. 2. p.* 485. Stony hills of the Pecos; June. (1302.)

Mulgedium pulchellum, *Nutt.; Torr. & Gray, Fl. 2. p.* 498; *Gray, Pl. Fendl. p.* 115. Banks of the Limpio and of the Rio Grande: also at the copper mines, New Mexico. (1303.)

Pyrrhopappus Carolinianus, *DC. Prodr. 7. p.* 44; *Torr. & Gray, Fl. 2. p.* 495. Along the Rio Grande, above El Paso; May. (1426.)

Crepis ambigua, *Gray, Pl. Fendl. p.* 114. On the sides of the Organ Mountains, northeast of El Paso; April. (1427.) — The specimens exactly accord with those of Fendler, except that the leaves and scape-like stems are rather more setose. The plant (undistributed) which I enumerated under this name in Wright's former collection (*Pl. Wright. p.* 129) is very different, and a true Hieracium, perhaps a less shaggy form of H. longipilum.

ADDENDA.

Peganum Mexicanum, *Gray, Pl. Wright. p.* 30, *adn.* Sides of the Chiricahui Mountains, Sonora; Sept., in flower and fruit. (1428.) — The stems are numerous from a deep and lignescent root, when old decumbent, attaining 10 or 12 inches in length. Seeds narrowly clavate-oblong, slightly curved, with a closely alveolate-reticulated testa. Embryo as in P. Harmala, but more slender. — The specimens were misplaced and so overlooked at the time of the distribution.

The following are described from specimens just received by Dr. Torrey, from Dr. Parry of the Mexican Boundary Commission, who collected them last autumn on the Rio Grande below New Mexico.

Cowania ericæfolia (*Torr. in litt.*): caule ramosissimo; foliis parvis linearibus margine valde revolutis cuspidatis subtus incanis; calycis tubo breviter turbinato; petalis albis. — Crevices of limestone rocks on the Rio Grande, below Presidio del Norte, *Dr. Parry.* — "A straggling bush, one or two feet high." Remarkable for its Heath-like leaves, which are only two or three lines long. Flowers smaller than in C. Mexicana.

Laphamia bisetosa (*Torr. in litt.*): "pygmæa, suffruticulosa, subviscoso-puberula; foliis oppositis et alternis parvis ovatis vel obovatis in petiolum attenuatis subdentatis vel integerrimis resinoso-atomiferis punctatis; capitulis solitariis sessilibus 6–8-floris; ligulis nullis; acheniis puberulis margine lævibus; pappo e setis 2 corolla dimidio brevioribus." — Crevices of rocks in a cañon of the Rio Grande, below Presidio del Norte? Oct., *Dr. Parry.* — Plant many-stemmed from a thickened and ligneous caudex, in the manner of the genus, from one to three inches high. Leaves crowded, barely three lines long, and with a petiole of about two lines in length. Head 3 or 4 lines long, terminating the short branches. Corolla 4-toothed. Bristles of the pappus equal, rather stout, minutely scabrous. — This is the second addition which Dr. Parry and Dr. Bigelow have made to this genus. It is the more interesting, on account of its bisetose pappus and few flowers, as it narrows the interval between the sections Monothrix and Pappothrix.

Perityle Parryi (sp. nov.): subviscoso-puberula; foliis plerisque alternis reniformi-cordatis crebre dentatis nunc sublobatis; ligulis lineari-oblongis discum

paullo superantibus; appendicibus styli fl. hermaph. attenuato-filiformibus; acheniis lineari-oblongis villoso-ciliatis, pilis crebris squamellis pappi æquilongis; arista unica gracillima barbellato-hispidula corolla disci paullo breviore. — In a cañon of the Rio Grande, with the preceding, *Dr. Parry.* — Heads on a slender and naked peduncle, as large as those of P. leptoglossa (4 or 5 lines long); the leaves more rounded and reniform, scarcely incised, of the same hue both sides, nearly an inch in diameter. Involucre shorter than the disk, viscid-puberulent like the leaves and branches; the scales lanceolate-linear. Ligules 2 or 3 lines long, yellow. Awn of the pappus 2 lines or more in length. Mature achenia not seen. This species ranks between P. leptoglossa and P. plumigera, most resembling the former. Its heads and flowers are thrice the size of those of the latter.

Perityle aglossa (sp. nov.): glabella; foliis sæpius alternis rotundatis subcordatis incisis lobatisve dentatis; involucri squamis angustissime linearibus; ligulis nullis; appendicibus styli angustis subulatis; acheniis lineari-oblongis marginibus vix incrassatis villosissimo-ciliatis, pilis squamellas pappi adæquantibus; seta unica barbellata corollam disci æquante. — In a cañon of the Rio Grande, with the two preceding, *Dr. Parry.* — Plant 6 to 12 inches high from a suffrutescent base. Leaves (in the specimen) only half an inch in diameter, minutely puberulent under a lens with viscid or resinous granules. Heads corymbose, as large as those of the foregoing species; the peduncles bearing two or three scattered setaceous bractlets. Scales of the involucre uniserial, remarkably narrow. Corolla 3 lines long. Branches of the style not so slender as in Perityle Parryi and P. leptoglossa, but much more so than in P. Californica and P. Acmella. Achenia fully a line and a half long, blackish, glabrate on the sides; the margins ciliate with a dense and strong fringe of hairs, a few of which are also borne on the base of the slender awn. The latter is about twice the length of the achenium. — This species, which is remarkable for the want of ray-flowers, certainly fixes the position of the genus Pericome (p. 81) in the immediate neighborhood of Perityle, as I had suspected.

*** The Cactaceæ of Mr. Wright's various collections will soon be published by Dr. Engelmann, in a separate memoir.

I have to correct a mistake respecting the gentleman to whose *memory* the genus Peteria was dedicated (p. 51 of the former memoir), as, I am informed, he is still living, although he has ceased to cultivate Botany.

ERRATA.

Page 76, line 10, for "NOVI BELGI," read "NOVI BELGII."
" 79, " 8 from bottom, for "S. MOLLIS," read "SOLIDAGO MOLLIS."
" 80, " 4, for "S. albicaulis," read "L. albicaulis."
" 97, " 8 from bottom, for "puppus," read "pappus."

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EXPLANATION OF THE PLATES.

PLATE XI. DRYOPETALON RUNCINATUM, p. 12.

Fig 1. A flower, enlarged.
" 2. A sepal, enlarged, seen from within.
" 3. A petal, enlarged.
" 4. The stamens and pistil, with the receptacle, equally enlarged.
" 5. A mature silique, cut across, enlarged.
" 6. Base of a dehiscent silique, more magnified, showing the seeds in place.
" 7. A seed, more magnified, transversely divided.

PLATE XII. *A.* AMOREUXIA SCHIEDEANA, Planch. (non Pl. 3), p. 26.

Fig. 1. A fruit, of the natural size.
" 2. A seed from the same, magnified.
" 3. The same, with the thin and fragile external integument, or testa, removed.
" 4. Longitudinal section of the seed, magnified, showing the homotropous embryo, &c.
" 5. Embryo detached, and more magnified.

PLATE XII. *B.* GLOSSOPETALON SPINESCENS, p. 29.

Fig. 1. Diagram of the flower.
" 2. A flower, enlarged.
" 3. Inside, and 4, outside view of a stamen, more enlarged.
" 5. The pistil, more magnified.
" 6. Vertical section of a flower through the ovary, showing the ovules, &c., magnified.
" 7. The fruit, with the persistent calyx, enlarged.
" 8. Vertical section of the same, showing the seed.
" 9. The seed with its carunculate arillus, magnified.
" 10. Transverse section of the same.

PLATE XIII. PSATHYROTES SCAPOSA, p. 100.

Fig. 1. A separate flower, magnified.
" 2. The corolla laid open, and the stamens, magnified.
" 3. A stamen, more magnified.
" 4. The style, equally magnified.

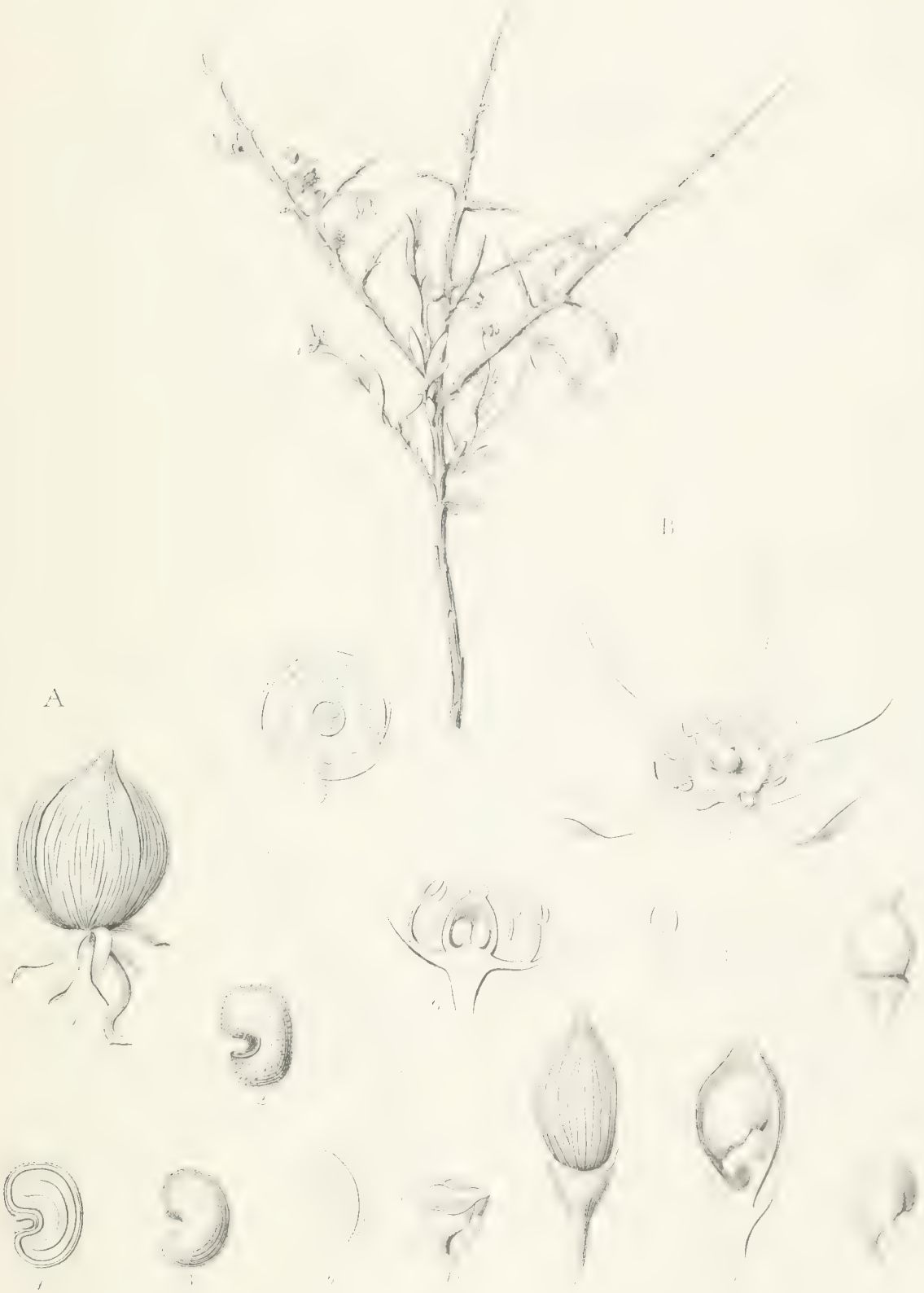
Fig. 5. The involucre and receptacle, from which the flowers have fallen, enlarged.
" 6. Achenium and pappus, magnified.
" 7. Vertical section of the achenium, showing the embryo, magnified.
" 8. Transverse section of the same.
" 9. One of the bristles of the pappus, highly magnified.

PLATE XIV. CALYCOSERIS WRIGHTII, p. 106.

Fig. 1. Receptacle (the scales of the involucre reflexed), with its capillary setæ, and a single flower, enlarged.
" 2. An anther, more magnified.
" 3. Summit of the style, equally magnified.
" 5. Achenium, with its exterior coroniform pappus, and the capillary pappus detached, magnified.
" 6. Transverse section of a five-ribbed achenium, magnified.
" 7. Similar section of a six-ribbed achenium.
" 8. A separate bristle of the inner pappus, more magnified.

EXPLICIT. KAL. FEB. MDCCCLIII.

DRYOPETALON RUNCINATUM.



AMOREUXIA SCHIEDEANA. GLOSSOPETALON SPINESCENS

PSATHYROTES SCAPOSA.

Sprague

CALYCOSERIS WRIGHTII.

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